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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Alignment of atmospheric mineral dust due to electric field" *by* Z. Ulanowski et al.

Anonymous Referee #2

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The manuscript presents novel measurements indicating the electric-field alignment of mineral dust particles in the atmosphere. The magnitude of the effect is not demonstrated to have large impact, however it is an interesting phenomenon that must be taken into account in the interpretation of observations. I recommend publication following minor revision.

The manuscript does a credible job of semi-quantitatively investigating a somewhat new phenomenon, not new in the sense that particle alignment is well-known to occur for ice particles in thunderstorms, but new with respect to mineral dust in a non-thunderstorm environment. While an interesting phenomenon, and while it may affect the interpretation of satellite, and other (esp. polarimetric), observations, the impact of the phenomenon on the atmosphere appears not large ($<$10%). The treatment is

not fully quantitative due to the speculative aspect of inferences about potential mechanisms for the production of the electric field, and due to the simplifying geometrical assumptions used in the derivation of possible electric field strengths. While perhaps not necessary to go too far beyond simple assumptions for an initial work such as this, the simplifying assumptions should be better acknowledged (points 6, 9, 10 below). In spite of the lack or rigor in spots, this manuscript does a nice job of "mapping out the territory" for this phenomenon and laying the foundation for future work. Subject to the relatively minor suggestions below, the new ground covered by this manuscript merits its publication.

Specific points:

1. "instruments may not be able to resolve the non-uniquness": may not -> can not

2. p.4, description of fig. 2: "showed that the Canary Islands were on the periphery" - but where are the Canary Islands? – please show on the figure.

3. p.5: "optical depth data was obtained": was -> were

4. p.5, description of fig. 4: there is reference to "columnar size distributions". Can this be better defined, and its purpose elucidated?

5. p6, top: "field gradient" – this appears elsewhere too, and it appears the phrase should either be "potential gradient" or "field" or "electric field" – it is really not the gradient of the electric field that is of concern.

6. p. 10, after eqn (14): what are the assumptions that enable a Boltzmann's law term to be written for fluid flow. What particle sizes does this apply to?

7. p.11: a field of 1600 kV/m is cited. This seems very large. How does this compare to thunderstorm electric fields. Would this initiate a discharge?

8. p12: "electric field with vertical gradient of the order of about 1 kV/m". Should re-phrase, as the field does not have the gradient, the potential does.

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9. p.15, top: "In the limiting case of the conductivity being much smaller that the free atmosphere value the full ionosphere-Earth electric potential difference would appear between the top and bottom of the layer." It is really not the conductivity being small that is the condition, rather an integrated quantity, the columnar resistance over the layer and how that compares to the columnar resistance of the rest of the column.

10. a complication here is that if the conductivity in the layer becomes so limiting, it will no longer be the case that the current density will be the same; there will be a tendency for the current to flow around the obstruction; assumption of constant current will give an overestimate to the field; this is an oversimplification

11. p.15 "1 kV/m as the minimum field gradient" – better if "field" rather than "field gradient"

12. p.16, it is recommended that field measurements be made. This is a very good point. In addition, it would be valuable to measure conductivity as well.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 13203, 2007.