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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Mixing of dust and NH_3 observed globally over anthropogenic dust sources" *by* P. Ginoux et al.

Anonymous Referee #1

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1. This paper explores the correlation between mineral dust aerosol and ammonia gas sources in the atmospheric column. The correlation is high over agricultural land, primarily in the spring season, and is attributed to anthropogenic activity. From previous work, they conclude that 7% of the global dust burden is associated with such sources, indicating significant anthropogenic control over the global dust aerosol budget. Here they determine that dust mixed with ammonia represents 22% of the global agricultural dust load, and they point out the implications for the direct and indirect environmental impacts of dust aerosol being associated with ammonia salts. They go on to assess regional behavior and the radiative contribution of this dust component, using AERONET data to constrain the mass extinction efficiency of the dust particles. This paper addresses a significant and interesting issue, and should be published in ACP. Some questions and suggestions are included below.

2. Line 68. Do you mean "... the spectral variation of the single scattering albedo" to increase with wavelength, or just "... the single scattering albedo " to increase with wavelength?

3. Lines 73-74. It might be appropriate to summarize in a few sentences here the validation results, and in particular, the uncertainties, of the M-DB2 DOD product.

4. Line 87. You attribute the range in MEE to uncertainty. This is of course a factor, but might actual variations in MEE for different dust populations also be important?

5. Lines 106-108. I'm not expert in the IASI retrievals, but are there any independent validation data to test the separation of dust from ammonia? This seems important for the current application.

6. Figure 1. I'm surprised at the apparently large amount of pasture assigned to the interior of the Saudi Peninsula.

7. Lines 131-145. Many of the agricultural areas where the presence of airborne dust is interpreted as coming from local sources are actually downwind of major natural dust sources. These include eastern Australia, Patagonia, northern India, and eastern China. If the dust is transported and elevated relative to the ammonia source, the two species might not interact as much as you assume.

So I'm wondering if there might be some way to distinguish locally generated dust from transported dust in these regions. Two thoughts – (1) perhaps use your M-DB2 technique to see what the dust burden is upwind of the agricultural areas at the key times, and (2) as MODIS and CALIPSO are both in the A-Train, it might be possible to use the vertical distribution of dust from CALIPSO to separate transported from locally generated dust.

8. Lines 154-162. Do you have any uncertainty estimates for these numbers?

9. Line 177. "... is then multiplied by an assumed dust density..." I don't know how much it matters to your conclusions, but the dust density was not actually measured

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here, and I don't think its variability between different sources was taken into account.

10. Lines 215-217. I think you need to go further to show that they have a common origin. For example, regional winds in upwind dust source regions might increase during northern spring, lifting more dust, and plants might start producing ammonia at downwind agricultural sites as they start to grow during the same season, without the ammonia and the dust actually coming from the same source. (See note 7 above.)

11. Lines 228-231. What are the uncertainties in the volume of non-spherical dust retrieved from AERONET remote sensing? At least a bound on the size of the uncertainty would be of interest.

12. Lines 269-271. How do you know the aerosol is in the near-surface layer corresponding to the RH values? If not, the lack of correlation might not be surprising.

Some minor copy editing would be helpful. For example:

Line 22. Should be "... other aerosol types..." Line 26. "... and (5) iron dissolution..." Line 31. "... of dust particles by sulfate occurs ..." Line 81. "...optical depth increased..." ... Etc.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 12503, 2012.