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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.

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We thank the reviewer for the constructive and helpful comments, and our reply is provided below. Based on the reviewer's comments, we made significant changes in the manuscript. In particular, we have added a figure and we used an additional land-use dataset.

Comment 2: We replace by "single scattering albedo"

Comment 3: We add the following sentence: They validated M-DB2 DOD by comparing with AERONET data. They showed significant correlation between M-DB2 and AERONET data, with root mean square difference of 0.26 and mean absolute difference of 0.24. The largest biases were observed in California and Australia where

M-DB2 largely overestimates DOD.

Comment 4: We remove the sentence to avoid the ambiguity.

Comment 5: This is indeed an important point. For the moment there are no independent data to test the contamination of sand/dust on the NH3 product. In fact total columns of ammonia are extremely hard to validate because of the large spatial and temporal variability. We believe however that our product is not majorly contaminated by the presence of dust. Sand or dust can affect infrared observed spectra in two different ways:

(1) Windblown dust or sand will typically give rise to a broadband absorption feature in the spectrum. See e.g. DeSouza-Machado, S. et al. Infrared dust spectral signatures from AIRS Geophys. Res. Lett., 2006, 33, L03801. Or Clarisse, L. et al. Retrieving radius, concentration, optical depth, and mass of different types of aerosols from high-resolution infrared nadir spectra Appl. Opt., 2010, 49, 3713-3722. Since our retrieval range was chosen narrow (940-970 cm-1)), the effects of a broad absorption feature are unlikely to affect the retrieval of ammonia too much, since any change in the baseline will be mostly compensated by the adjustment of the surface temperature in the retrieval process.

(2) Certain minerals present in sand such as kaolinite or gypsum give rise to sharp absorption features. See e.g. Sokolik, I. and Toon, O. Incorporation of mineralogical composition into models of the radiative properties of mineral aerosol from UV to IR wavelenghts J. Geophys. Res., 1999, 104, 9423-9444. These features can be present both in airborne dust or can show up as surface emissivity features (over deserts). As explained in the text, we use a high resolution emissivity data to remove most of the surface effects. However, when such sharp features are strongly present in the relevant spectral range the retrieval of ammonia might be affected. However, when these features cannot be reproduced by the forward model, this will show up in the residual in the fit, and such observations have therefore been removed by applying a

filter on the root mean square of the residue of the fit (as detailed in the text).

Comment 6: This is a very good point, and we now use 2 different datasets. We modify the Table and a Figure to show results for both land-use datasets. The major differences between them are over Australia and Saudi-Arabia, but the amount of dust mixed with NH_3 is similar with only 1% difference globally.

Comment 7: This is a good comment, and we thank the reviewer's suggestions. The problem with CALIPSO is the narrow swath (70 meters) and the very low probability that its overpasses coincide with small dust events from anthropogenic sources. Instead, we extract from the one year data a snapshot on May 16, 2009, when we found dust mixed with NH_3 over most continental regions. The new Figure shows that both are co-emitted from hot-spots except over Sahel where we can see that dust is transported from the Bodélé depression. So, this new Figure nicely shows that indeed there may be discrepancies in some areas, in particular Sahel. On the other hand, reviewer 2 mentioned a paper where NH_3 is also transported in the free-troposphere.

Comment 8: We now use 2 different land-use datasets, and results for both datasets are discussed.

Comment 9: We are now more specific, and the density is now defined as "uncoated dry dust density". Based on sampling data showing 2 to 6% sulfate by volume, we estimate the error to be of the order on 10%.

Comment 10: We add a new Figure which clearly show that dust and NH_3 are collocated over hot-spots, except in the case of a dust event over Sahel from the Bodélé.

Comment 11: We now provide some precision on AERONET uncertainty:

The AERONET retrieval algorithm in case of dust is described in details by Dubovik et al. (2006). Here, briefly, the algorithm assumes spherical particles, except when the Angstrom exponent is lower than 0.5, in which case spheroid models are used. For Angstrom less than 0.5, the estimated error is between 10 and 20% for Level 2 data.

Comment 12: We modified the manuscript and discussed the possible reasons for the lack of sensitivity of RH on FMEE.

Comment 13: corrected.

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