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Comment

Interactive comment on “Biogenic emissions of NO_x from recently wetted soils over West Africa observed during the AMMA 2006 campaign” by D. J. Stewart et al.

Anonymous Referee #2

Received and published: 26 January 2008

There is no doubt that the manuscript by Stewart et al. is of high scientific significance. It is basically worthwhile to be published in ACP. However, scientific quality as well as presentation quality of the paper is still not matching the high level of scientific significance. Like referee#1, I suggest significant revisions of this paper and/or merging with another AMMA Special Issue paper (see below).

comments:

page 16255, line 22-24

It is strongly recommended, that in a revised version of the paper, a certain piece of text

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Interactive Discussion

Discussion Paper



should be found, where the issue of the atmospheric transformation of NO to NO₂, the (fulfilled/not fulfilled) assumption of photostationary equilibrium between NO-NO₂-O₃, etc. is elucidated to potential (non-specialized) readers of ACP.

page 16257, lines 3-6 (and elsewhere)

the problem of non-specific conversion of the molybdenum converter (TECO) is addressed; however, discussion and conclusions from the data < 1 ppb certainly still need more quantitative elaboration (particularly some enhanced statistical analysis of uncertainties). The results of Steinbacher et al. (2007) would expect 27-50 % systematic overestimation by the TECO instrument (rather than only 16% as found by the authors). The findings of Dunlea et al. (ACP, 7, 2691-2704, 2007) would rather support 50 % systematic overestimation. In this respect the authors' own findings on page 16265, line 16-19, namely "in the latter case the PAN levels were of the order of 60 ppt whilst the TECO instrument was overestimating NO_x by around 200 ppt" will certainly grab the critical attention of any (experienced) reader.

page 16264, eq. (1)

The validity of eq. (1) presumes a variety of (justified?) assumptions (as stated by the authors), e.g. negligible horizontal and vertical advection of NO_x, as well as negligible vertical divergence of NO-, NO₂-, and O₃-fluxes in the entire atmospheric boundary layer. The serious problem of (NO-, NO₂-, O₃-, etc.) advection has been already addressed by referee#1 (Delon et al.), as well (to some extent) by referee#1 of this paper. However, the neglecting vertical divergence entirely (just on the assumption of complete vertical mixing) seems a bit risky (without any further proof). Is there no support (for "complete" mixing) from vertical profiles of (virtual) potential temperature, or any other scalar quantity? How, Delon et al. (2007) have handled this problem?

page 16264, eq. (2)

this equation contains definitely the wrong sign in the exponent of the (most right hand

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side) exponential function.

page 16265, line 7

The dry deposition of NO₂ to west African soils (vegetation?) may be low, but $v_d(\text{NO}_x) = 9 \times 10^{-2}$ cm/s could be considered dramatically low. Giving the rich treasure of related literature, the authors are kindly asked to consider more than only one reference for it (a few examples are given below; "references (1)").

page 16255, line 18-21, page 16260, first para, page 16266, line 17-18, page 16267, first para, and page 16267, line 16-18

The authors obviously do not belong to the biogeochemistry/soil flux community. For a revised version of their paper, the authors may consider the fact, that the biogenic NO emission ($F(\text{NO})$) from soils is a strongly non-linear function of soil moisture (water filled pore space, WFPS), i.e. the emission follows an optimum curve (the reviewer suggests for semi-arid, sandy soils: a narrow maximum of $F(\text{NO})$ around $\text{WFPS} \leq 0.2$). This fact may help in particularly interpreting the results in sub-chapters 3.2 and 3.3. It will particularly address the question of biogenic NO emission vs. wetting and/or (fast?) drying of soils. By the way, on page 16267, line 5, the authors claim to have used data of satellite measurements of soil moisture. So, if data on soil moisture are available, why not to make explicitly use of the known dependence of $F(\text{NO})$ vs. WFPS? The authors will find a lot of information and helpful support in this direction in the papers cited at the end of referee#2's comments ("references (2)").

page 16265, ff.

Like referee#1 of this paper, referee#2 also wonders that "the authors assume that soils that have not been wetted recently do not emit NO_x". The authors are kindly referred to corresponding literature which will provide them with some helpful data and material (given at the end of referee#2's comments, ("references (3)"). Particularly, the authors may find in Otter et al. (1999) interesting information on the effects of "pulsing" and

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Interactive Discussion

Discussion Paper



re-wetting on the biogenic emission from semi-arid African soils.

page 16266, line 12

there is a more recent review on "NO from soils …. for a variety of land surface types in Africa and other tropical regions" than the 1977 review of Davidson and Kinglerlee (namely, Meixner and Yang, 2006, see "references (3)").

page 16267 and 16268, section 3.6

referee#2 agrees 100% with referee#1 of this paper, as far as criticism on the authors' flux estimates is concerned.

page 16269, line 6-8

to judge whether or not "Figure 7 shows a good correlation….", some more information, e.g. statistical quantities ($n = ?$, $P(0.05)$, $P(0.01)$, etc.) might be helpful.

The referee of this manuscript (Stewart et al.) is also referee of another paper (De- lon et al., Nitrogen oxide biogenic emissions from soils: impact on NO_x and ozone formation in West Africa during AMMAACPD, 7, 15155–15188, 2007), which has been also submitted to the ACP Special Issue on the AMMA 2006 campaign. The authors of the present paper have mentioned that in their manuscript once, page 16256, line 10-18. There are only two more citations of the paper by De- lon et al., namely page 16262, line 2-5 and page 16269, line 10-12. In turn, De- lon et al. made only two (minor level) refernces to Stewart et al., namely on page 15167, line 19-22 and page 15168, line 15-16. Both papers make some mutual use of data and/or results. It is undoubtful that both papers share an identical aspect of one of the major present time scientific endeavours (the AMMA project). On the other hand, the reader of both papers (in their present form) is hardly able to deny a substantial lack of co-ordination between both papers. However, that would not only be desirable from a scientific point of view, it is being supposed to have occurred with respect to the well-known and high level of (scientific) co-ordination

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Interactive Discussion

Discussion Paper



within the AMMA project. In their present form, both papers received substantial criticism (see: <http://www.cosis.net/members/journals/df/article.php?paper=acpd-7-16253>, and <http://www.cosis.net/members/journals/df/article.php?paper=acpd-7-15155>, particularly with respect to "not very thorough comparison between the different soil NO_x emission methods/simulation results with the measurements" and to considerable "flaws in the interpretation of flux measurements and their extrapolation". The referee feels, that more and also more comprehensive co-ordination of both papers would easily overcome these criticisms. Moreover, with respect to the high importance of the common scientific issue, it is strongly recommended to join both papers; any (anticipated) arguments about an (oversized) length of such a joined paper should not discourage the authors: two (companion) papers sharing the same title, but separated into "Part I" and "Part II" should even increase the attractiveness and importance of both papers.

minor corrections:

page 16255, line 3 "Prather and Ehhalt" rather than "Prater and Enhalt"

(1) references for dry deposition of NO₂:

Horii, C.V., Munger, J.W., Wofsy, S.C., Zahniser, M., Nelson, D., McManus, J.B. (2006), Atmospheric reactive nitrogen concentration and flux budgets at a Northeastern U.S. forest site, *Agricultural and Forest Meteorology*, 136 (3-4), 159-174.

Zhang, L., Brook, J.R., Vet, R., Wiebe, A., Mihele, C., Shaw, M., O'Brien, J.M., Iqbal, S. (2005), Estimation of contributions of NO₂ and PAN to total atmospheric deposition of oxidized nitrogen across Eastern Canada, *Atmospheric Environment*, 39 (37), 7030-7043.

Michou, M., Laville, P., Serça, D., Fotiadi, A., Bouchou, P., Peuch, V.-H. (2005), Measured and modeled dry deposition velocities over the ESCOMPTE area, *Atmospheric Research*, 74 (1-4), 89-116.

Park, S.-U., Lee, Y.-H., Lee, E.-H. (2002), Estimation of nitrogen dry deposition in South Korea, *Atmospheric Environment*, 36 (31), 4951-4964.

Wesely, M.L., Hicks, B.B. (2000), A review of the current status of knowledge on dry deposition, *Atmospheric Environment*, 34 (12-14), 2261-2282.

Smith, R. I., Fowler, D., Sutton, M.A., Flechard, C., Coyle, M. (2000), Regional estimation of pollutant gas dry deposition in the UK: model description, sensitivity analyses and outputs, *Atmospheric Environment*, 34 (22), 3757-3777.

Padro, J., Zhang, L., Massman, W.J. (1998), An analysis of measurements and modelling of air-surface exchange of NO-NO₂-O₃ over grass, *Atmospheric Environment*, 32 (8), 1365-1375.

Erismann, J.W., van Pul, A., Wyers, P. (1994), Parametrization of surface resistance for the quantification of atmospheric deposition of acidifying pollutants and ozone, *Atmospheric Environment*, 28 (16), 2595-2607.

Wesely, M. L. (1989), Parameterization of surface resistances to gaseous dry deposition in regional-scale numerical models, *Atmospheric Environment*, 23 (6), 1293-1304.

(2) references for the dependence of biogenic NO flux from soil moisture:

Meixner, F.X., Yang, W.X. (2006), Biogenic emissions of nitric oxide and nitrous oxide from arid and semi-arid land, pp. 233-255, in: *Dryland Ecohydrology*, P. D'Odorico and A. Porporato (eds.), p. 341, Springer, Dordrecht Berlin Heidelberg New York (ISBN : 1-4020-4261-2).

van Dijk, S.M., Gut, A., Kirkman, G.A., Gomes, B.M., Meixner, F.X., Andreae, M.O. (2002), Biogenic NO emissions from forest and pasture soils: Relating laboratory studies to field measurements, *J. Geophys. Res.*, 107, D20:8058, 2002.

Ludwig, J., Meixner, F.X., Vogel, B., Förstner, J. (2001), Processes, influencing factors, and modelling of nitric oxide surface exchange; an overview, *Biogeochemistry*,

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52(3), 225-257.

Davidson, E.A. (1992), Sources of nitric oxide and nitrous oxide following wetting of dry soil, *Soil Science Society of America Journal*, 56, 95-102.

Skopp, J., Jawson, M.D., Doran, J.W. (1990), Steady-state aerobic microbial activity as a function of soil water content, *Soil Science Society of America Journal*, 54, 1619-1625.

(3) references concerning biogenic emission of NO from arid and semi-arid ecosystems:

Aranibar, J.N., Otter, L., Macko, S.A., Feral, C.J.W., Epstein, H.E., Dowty, P., Eckardt, F., Shugart, H.H., Swap, R.J. (2004), Nitrogen cycling in the soil-plant system along a precipitation gradient in the Kalahari sands, *Global Change Biology*, 10, 359-373.

Otter, L.B., Yang, W.X., Scholes, M.C., Meixner, F.X. (1999), Nitric oxide emissions from a Southern African savanna, *Journal of Geophysical Research*, 104 (D15), 18,471-18,485.

Meixner, F.X., Fickinger, Th., Marufu, L., Serca, D. Nathaus, F.J., Makina, E., Mukurumbira, L., Andreae, M.O. (1997), Preliminary results on nitric oxide emission from a southern African savanna ecosystem, *Nutrient Cycling in Agroecosystems*, 48, 123-138.

Meixner, F.X., Yang, W.X. (2006), Biogenic emissions of nitric oxide and nitrous oxide from arid and semi-arid land, pp. 233-255, in: *Dryland Ecohydrology*, P. D'Odorico and A. Porporato (eds.), p. 341, Springer, Dordrecht Berlin Heidelberg New York (ISBN : 1-4020-4261-2).

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 7, 16253, 2007.

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