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Atmospheric Chemistry and Physics Discussions

ACPD

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Interactive Comment

Interactive comment on "Ozone budget in the West African lower troposphere during the AMMA (African Monsoon Multidisciplinary Analysis) campaign" *by* M. Saunois et al.

M. Saunois et al.

saum@aero.obs-mip.fr

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The referee has raised an interesting point regarding our conclusion about the contribution of VOCs emitted in the south of the study region on the ozone production in the north. Firstly we would like to point out that we are not suggesting that this is the only factor contributing to the ozone maximum in the north. In the abstract and conclusions we quite clearly say that this is in combination with the high NO_x emissions from the soils in the north and that the ozone minimum in the south is driven by dry deposition to the trees. Together these factors all affect the north south difference of 15 ppb. The ~5 ppb reduction in the ozone concentrations in the north (and in this gradient) for the run with no isoprene emissions demonstrates that the VOC emissions in the south do impact the ozone production in the north, but that other factors mentioned in the abstract and conclusions (deposition and soil NO_x) are important. Also other VOCs besides isoprene are emitted by vegetation as listed in Table 3 in the article.

We do not specify individual VOCs as being the cause of the O_3 production in the north so do not believe we need to quantify their relative contributions. We do however agree with the referee that CH_4 and VOCs emitted directly into the northern region will have contributed to the peroxy radicals responsible for the ozone production there and it would be useful to better quantify this. We have therefore performed some sensitivity studies along the lines suggested by the referee, namely:

- A run with no CH_4 (NOCH4)
- A run with no VOC emissions north of 12°N (NNVOC)
- A run with no VOC emissions south of 12°N (NSVOC)

Also, in Figure 11, the term HO_2 + NO was missing and is the major contributor (ahead of MO2) of the NO to NO_2 conversion in the north. The corrected Figure 11 is included with this response (Fig. 1).

Omitting CH_4 decreases MO2 concentrations by a half to two thirds of the levels in the base run, and HO_2 by ~13% at 15°N (not shown). CH_4 is the major contributor to MO2 formation, especially to the north where MO2 reaches its maximum (16°N). Without CH_4 ozone chemical production decreases in the north only (by 20%) whilst ozone concentrations decrease by ~3 ppb in the south and by ~9 ppb in the north (see the included Figure 2 which shows ozone meridional profiles). CH_4 does have an impact on the ozone gradient (~6 ppbv).

Switching-off VOC emissions north of 12°N (NNVOC) has no significant impact on the ozone levels or the gradient, but shifts the maximum slightly to the north.

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RUN Name	O_3 min (ppbv) ~11°N	O_3 max (ppbv) ~16°N	O_3 diff (ppbv) (grad.)
RETRO	23	40	17
NOSIO	24 (+1)	36 (-4)	12 (-5)
NOANT	21 (-2)	38 (-2)	17 (=)
IDSOL	23 (=)	33 (-7)	10 (-7)
NODEP	34 (+11)	46 (+6)	12 (-5)
NOCH4	20 (-3)	31 (-9)	11 (-6)
NNVOC	23 (=)	40 (=)	17 (=)
NSVOC	23 (=)	35 (-5)	12 (-5)

Table 1. Values of the ozone minimum, maximum and gradient in ppbv relative to each runs including the new sensitivity tests.

Switching-off VOC emissions south of 12°N (NSVOC) has a similar effect to switching-off isoprene emissions (the major species of VOC): only ozone levels north of the vegetated areas are impacted. This remains an interesting result and the northward advection of materials (like longer lived species) is a way to explain this.

Table 1 illustrates that the ozone latitudinal profile, with a minimum over the trees and a maximum to the north can be attributed to several factors. The largest impact on the gradient (~7 ppb) is from the difference in NO_x emissions (concentrations) between the north and the south. The ozone production in the north requires organic precursor species. As we said previously some of this comes from NMVOCs emitted in the south and clearly indicates a significant role of the northward advection of these VOCs in the establishment of the gradient (~5 ppb contribution). In addition, as pointed out by the referee, CH_4 is a precursor of peroxy radicals and it contributes a similar amount (~6 ppb) to the ozone gradient. Dry deposition is also important as it preferentially reduces the ozone over the trees such that it contributes ~5 ppb to the gradient and thus effectively accentuates the northerly maximum by this amount.

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Based on the results of these runs we will refine our conclusions. We will re-word the abstract and conclusion to include the impact of CH_4 and clarify the secondary role of the northward advection. We thank the referee for opening this debate and would like to encourage she/he to submit their remaining comments.

Figures included:

- Fig. 1: The corrected Figure 11
- Fig. 2: Ozone meridonal profiles for some of the runs (including the new sensitivity tests)

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 6979, 2009.

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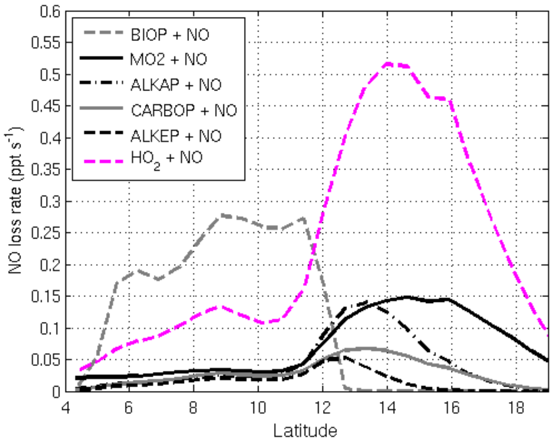

Fig. 1. Fig. 11 (corrected). NO loss rates for the base run (RETRO).

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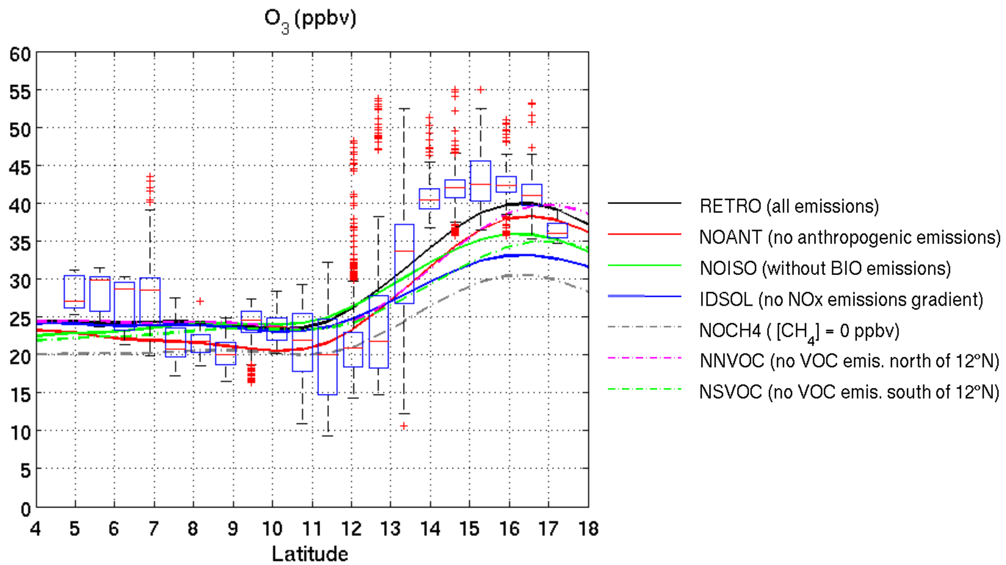

Fig. 2. Ozone meridional profiles: same as Fig.7 a, except that NODEP and OHRE2 runs are removed and that NOCH4,NNVOC, NSVOC run results are shown.

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