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Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #1

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Saunois et al. have used a 2D latitude-altitude model of West Africa to examine to ozone budget in the boundary layer over this area during the AMMA field measurement campaign. The major features of the observed boundary layer ozone distribution over this area are a mixing ratio minimum over the southern, vegetated area, and a maximum over the more arid northern latitudes. Their model generally does a reasonable job of reproducing this pattern, as well as the mixing ratios and meridional gradients of several other trace gasses observed during the campaign. Using a combination of budget analysis and sensitivity studies, Saunois et al. attempt to determine the main processes controlling the ozone budget in this region. They conclude that dry deposition drives the ozone minimum over the forested region, and that northward

transport of VOC-influenced air masses contributes to the ozone maximum at higher latitudes.

My major concern with this paper is that the authors give too much prominence to this northward transport of VOC-influenced air masses as an ozone production mechanism. This may in fact be the case, but they have not adequately quantified the relative contribution of this mechanism to the modelled northern ozone maximum. Nevertheless, only this mechanism is mentioned in the abstract and the conclusion of the manuscript, giving it a potentially misleading prominence. They do not say which VOC are responsible for this enhanced ozone production, but if the northward transport of VOC-influenced airmasses really were such a large contributor to ozone formation in the north, then one might expect to see significantly lower ozone mixing ratios there when emissions of the major species of VOC in the model, isoprene, is switched off in their NOISO run. Figure 7(a) does show a sensitivity of about 5ppb in the northern ozone maximum to the switching off of isoprene emissions, but this is only about one third of the modelled north-south difference in ozone (15ppb). Perhaps there are more factors contributing to this northern ozone maximum than just transport of VOC-influenced air masses, at least in their model.

In Figure 9, the authors show quite clearly that enhanced chemical production of ozone is the driving term in the ozone budget in the northern part of their domain. This is most likely linked to their enhanced emissions of NO from soils in this region. In Figure 11, the authors attempt to understand the nature of this enhanced ozone production by examining the rates of reactions with peroxy radicals (intermediate products of VOC oxidation) converting NO to NO2 (which can then undergo photolysis, ultimately yielding ozone). This is exactly the kind of budget analysis which is needed, but unfortunately the authors have not gone far enough with this analysis. They show, for example, that the major peroxy radical responsible for the NO to NO2 conversions is MO2 (methyl peroxy radical). This radical is an intermediate oxidation product of many different VOCs, including isoprene, other biogenic VOCs, the anthropogenic VOCs emitted in

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both the northern and southern parts of the modelling domain, and methane, a VOC which is present at the ppm level throughout the troposphere. In order to make conclusions about which VOCs are responsible for the enhanced ozone production, the authors must quantify the relative contributions of each candidate VOC to the peroxy radicals shown in Figure 11.

This analysis could either be achieved with a kind of "colouring" or "tagging" of VOC oxidation products according to their primary VOC, or with a series of sensitivity studies, in which each individual VOC or class of VOCs is switched off in the model. The authors have already performed one such sensitivity study with isoprene emissions, their NOISO run. Other possible sensitivity studies could be turning off all anthropogenic VOC emissions north or south of (say) 11° N, and a run with a background methane mixing ratio of 0.

Until the authors have taken steps to quantify the relative contributions of different VOCs to the enhanced ozone production in their model, they are not justified in giving prominence to any one particular VOC (or class of VOCs) as the cause of this enhanced production. They should either perform such an analysis, or remove (or at least tone down) their claims about northward transport of VOC- influenced air from the abstract and conclusions.

I do have other comments on this manuscript, but they are of a relatively minor nature compared with the issue mentioned above. In the hope of stimulating discussion on this particular issue, I shall withhold my other comments for the time being.

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