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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "$HO_x$ observations over West Africa during AMMA: impact of isoprene and $NO_x$" *by* D. Stone et al.

**Anonymous Referee #1**

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This paper presents observations of OH and HO2 made during the AMMA campaign flights over West Africa during the summer of 2006, and examines the ability of a box model to reproduce observations with a focus on the impact of isoprene on the HOx budget and the impact of isoprene in forested regions. Overall, I find the paper to be organized and presented well. However, there are two issues I have with the discussion. Once these issues are clarified, I recommend publication. Several minor points are listed at the end.

Constraint of CH2O: Because the oxidation of VOCs flows through CH2O on the way to radical and O3 production, the constraint of CH2O to observations effectively short-circuits the chemical cycling in a model. An argument can be made for constraint of CH2O for budget purposes, such as in Figures 7 and 9. However, for sensitivity



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analyses, such as for Figure 9 and accompanying discussion, CH2O must certainly be allowed to vary with changing VOC concentration. It is unclear from the paper whether CH2O is model-calculated for these sensitivity runs. Discussion of the single point for modeling (line 17 p. 17045) indicates specifically that CH2O is constrained. Discussion in Section 5.2, line 21 p. 17046 indicates that isoprene and NOx are varied "...while maintaining all other species at their observed levels (Table 3)." However, Table 3 does not list CH2O as a constraining species. I suspect that the authors conducted the simulations appropriately and did not constrain CH2O and other aldehydes, and that this simply needs to be stated in the discussion. If this is not the case, then the simulations need to be run without constraint of CH2O and other aldehydes. For the overall analysis, it might be worth running the model with CH2O unconstrained and see if there is much of an impact on overall results.

Figure 9: This figure is not intuitive and is quite confusing. It is described in the text (lines 22-26, p. 17046) as "...showing the effects of increasing isoprene concentration under different isoprene and NOx regimes." However, the only way I can make sense of the Figure is that it shows the effects of *decreasing* isoprene concentration. The caption indicates that it shows HO2 relative to a run where isoprene has been increased by a factor of ten, suggesting that this latter interpretation is correct (and is consistent with the later figure discussion). My preference would be to show the change in HO2 due to increasing isoprene. However, whichever way the authors choose, it needs to be clearly described.

The discussion of the low NOx regime 10-50 ppt (top of p. 17047) concerns me. The discussion describes this regime as where HO2 decreases with increasing isoprene concentration (indicated by the yellow/orange colors on the Figure). No mention is made of the blue shades within this NOx regime at the highest isoprene levels at the top of the plot however, and in fact, the average GABRIEL point (red diamond) falls into this area. The blue shades indicate increasing HO2 with increasing isoprene, which seems inconsistent with discussion of GABRIEL (line 14, p. 17048) "Under these con-



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ditions, peroxide production will be a significant sink for HOx in the model." Later, in the discussion of the very low NOx (< 10 ppt), the blue colors at the highest isoprene concentrations are described as due to CH2O from ozone reactions with isoprene. From this discussion alone, I would conclude that GABRIEL conditions are also affected by these conditions. Some clarification here is required.

MINOR POINTS:

Abstract: Might be helpful to include median NO level (3-500 ppt is a large range).

Introduction (paragraphs beginning line 26 p. 17033): Because this study is limited to analysis of HO2, it would be helpful to include a few sentences describing the HO2 obs/calc ratio under high isoprene conditions during INTEX-NA and GABRIEL. For example, Section 5.1, line 22 p. 10744 compares HO2 obs/calc during AMMA to that in GABRIEL, so it would be helpful to outline HO2 results from GABRIEL in addition to outlining the OH results.

3. Model approach (line 22 p. 17039): How important are the HO2 and OH losses to aerosol relative to other budget terms? Are they significant at all? (they are not mentioned in budget discussion.)

Table 3: Range of NO listed as .3-500 ppt (typo?)

Section 5 Figure 5 The simple PSS model/obs figure seems to indicate two branches - one that falls along the 1 line, and another that falls above. Can these be discriminated with respect to geography? (i.e., I would suspect the points where simple PSS model gives good agreement are desert)

Section 5.1, line 22 p. 10744: Isoprene concentrations were much higher in GABRIEL than during AMMA. How do HO2 obs/cal compare for comparable isoprene levels?

Section 5.1 line 4 p. 17045: This is semantics, but you shouldn't describe the point as "typical" when it was chosen because it has higher isoprene and lower NO than most of the data during AMMA. You chose this point for a good reason, but not because it is



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"typical".

Section 5.1, line 11 p. 17046: I suggest rewording the section where you state "isoprene has little impact on HOx." I understand you intend to state that it has little impact on the total concentration of HOx, but it does have a significant impact on HOx partitioning.

Figure 9 caption "Model discrepancies observed during INTEX-A were found for isoprene > 2 ppb, but the corresponding NO concentration is not given (Ren et al., 2008)." These data are available on public archive (http://www-air.larc.nasa.gov/missions/intexna/intexna.htm) Note that there are only ∼35 points (∼2% of the BL data) during INTEX-A where isoprene was larger than 2 ppb, but for those points, median NO was 22 ppt (and median HO2 obs/cal = 2.4). This is consistent with your interpretation, so would be worthwhile citing.

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 17029, 2010.