Atmos. Chem. Phys. Discuss., 14, C10055–C10063, 2014
www.atmos-chem-phys-discuss.net/14/C10055/2014/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Biomass burning related ozone damage on vegetation over the Amazon forest" *by* F. Pacifico et al.

F. Pacifico et al.

federica.pacifico@gmail.com

Received and published: 11 December 2014

Response to M. O. Andreae (Editor) (acpd-14-C8192-2014)

I would like to raise some questions/comments regarding the ozone measurements that are being compared with the model output. The measurement height at the TT34 site is being reported as 54 m. According to Artaxo et al. (2013), the inlet height for ozone is 39 m. Based on our experience at the ATTO site, which is very similar to TT34, this can make a difference of almost a factor of two. Please verify which inlet height is the correct one.

R: We double-checked the information. Trace gas measurements at TT34 were made at 39 m a.g.l., while aerosol measurements at the same site were made at 54 m a.g.l.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

We have corrected the manuscript at page 19963 line 27.

An advantage of the TT34 site is that the tower is located in essentially undisturbed forest, so that strong horizontal gradients are not to be expected. This makes it a relatively good candidate for comparison with a low-resolution model. But pronounced vertical gradients exist in the height range from 0 to 100 above ground (see Rummel et al. 2007 and unpublished data from the ATTO site), which may seriously affect model/observation comparisons. The Porto Velho site is even more complex. To my knowledge, the measurements were made from a shelter located in a cleared area with adjacent forest. The air intake was not very high above the ground (5 m). This needs to be specified in some detail in the paper, since it can possibly explain a part of the model/observation discrepancies. Small-scale circulations between forest and clearing can bring significant amounts of sub-canopy forest air into the clearing, which can reduce O3 levels to near-zero, especially at low levels. This introduces considerable uncertainty into what type of air and what effective height is actually sampled at such a site.

R: We agree that the height at which ozone is measured have a crucial impact over the comparison between measurements and model. More information about the height of detection for each site was added to the 'Model site-level Evaluation' section (page 19963). The following sentence was added to the 'Discussion and Conclusions' section (page 19967 line 17): "The measurement level may explain part of the model overestimation, since it is well known that O3 mixing ratios strongly decrease with height due to deposition within the canopy. The lowest layer of the model is 48 m (which corresponds to canopy top over vegetated grid-cells), while measurements were taken at 5 m and 39 m a.g.l. respectively at Porto Velho and ZF2. Rummel et al. (2007) reports a 5-15 ppb O3 decrease from 52 to 11 m a.g.l. in a forest site in Amazonia."

These considerations point to a more general issue, which is the difficulty of comparing model results with observations for a species with strong near-surface gradients. The paper points out that the lowest model layer depth is 48 m. It needs to be stated

ACPD
14, C10055–C10063, 2014

whether this is 48 m from the ground surface or from the canopy top.

R: Please see the comment above.

In the Amazon forest, the mean concentration in the 0-50 m layer would be typically about 1/3 or $\frac{1}{4}$ of that in the 30-80 m layer (heights relative to or the ground); for example in the dry season at ATTO, 3 ppb vs 10 ppb. A corollary of this is that for model/observation comparisons of ozone over vegetated surfaces, measurements at a single level may not be very useful. Instead, one needs to measure a profile and then extrapolate to a height (maybe 100 m over forest, 50 m over grass) where concentration gradients become small. The results in this paper highlight the general difficulty models have in accurately predicting ozone over vegetated surfaces, especially in clean regions. I suspect this is dominated by underestimation of surface deposition to vegetation, but incorrect treatment of vertical mixing and problems with clean-air oxidant chemistry may also play a role. In your paper you correctly point out that for plants there is a compensation effect, when concentrations are overestimated while deposition velocities are underestimated. (Actually, I think there is an error in the text: "Underestimating the O3 dry deposition flux not only leads to a positive bias in the O3 concentration, and consequently an underestimation of the damage caused by O3,: : :" – shouldn't it be "overestimation" here?).

R: To clarify this concept we have added, at page 19968 line 16: 'However, the total O3 flux (or dose) is a function of both O3 surface concentrations and dry deposition, i.e. for plants there is a compensation effect when concentrations are overestimated while deposition velocities are underestimated. Underestimating the O3 dry deposition flux implies reduced O3 plant uptake, and consequently an underestimation of the plant damage and productivity losses. However, it also leads to higher O3 concentrations, which subsequently act to increase plant O3 uptake and damage, compensating for the initial effects on productivity.'

BUT, for human exposure, it is actually the concentration at 2 m that is relevant. Given

ACPD
14, C10055–C10063, 2014

the importance of a correct representation of O3 deposition, the paper should contain a comparison between the deposition velocities used in the model and those obtained in field studies, particularly Rummel et al. (2007).

R: We have included a comparison against Rummel et al. (2007) ozone deposition fluxes in the supplementary material.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/14/C10055/2014/acpd-14-C10055-2014-supplement.zip

---

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 19955, 2014.

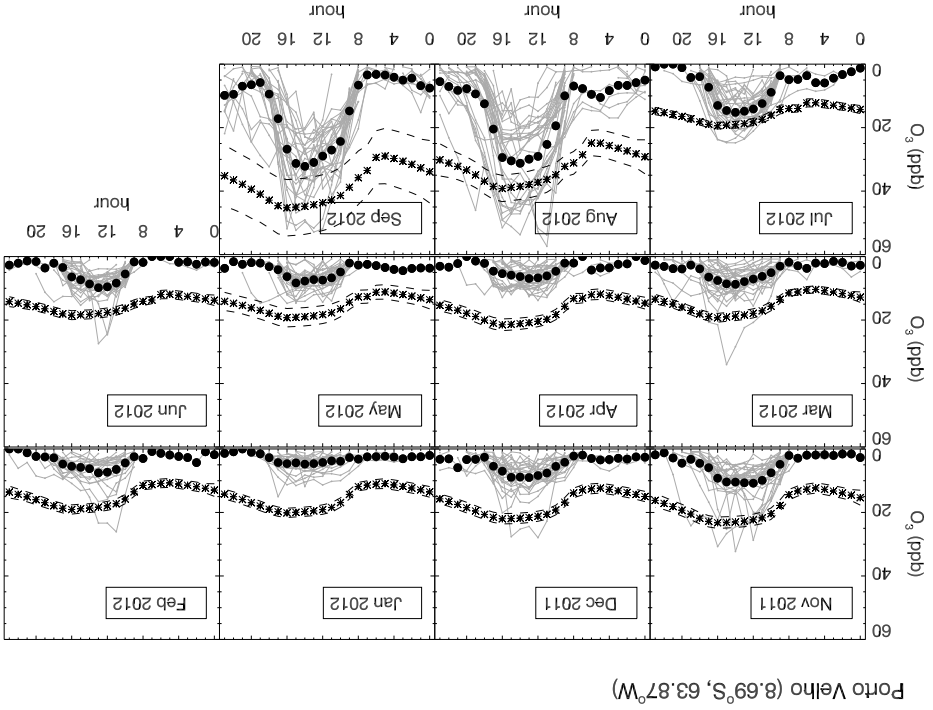

Fig. 1.

ACPD
14, C10055–C10063, 2014

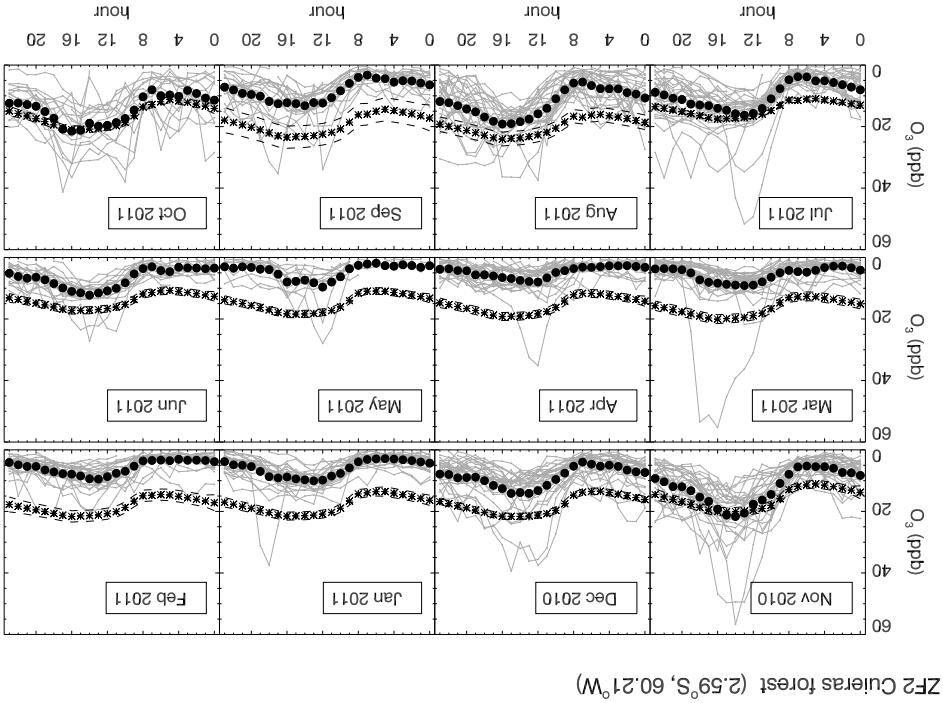

Fig. 2.

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

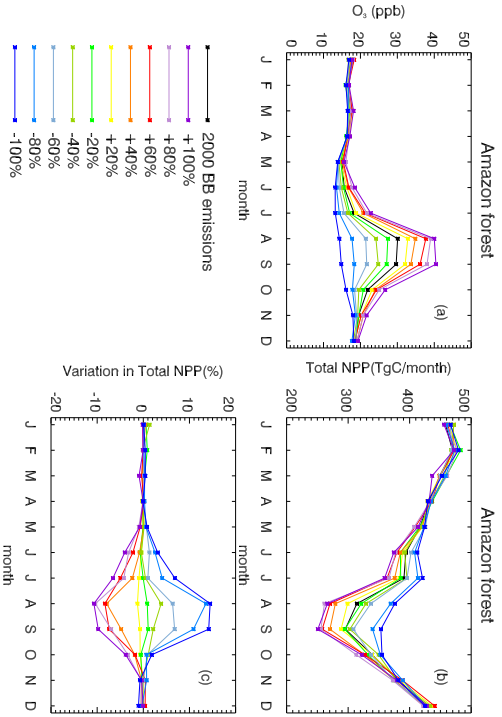

Fig. 3.

ACPD
14, C10055–C10063, 2014

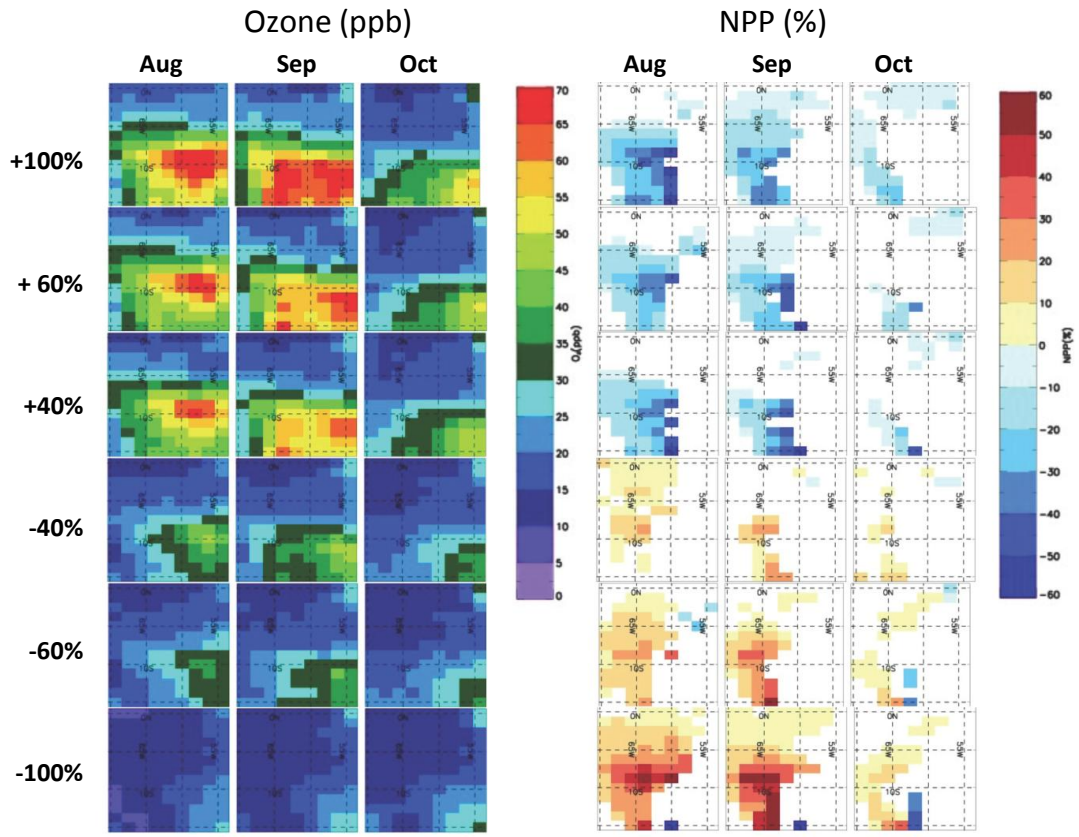

Fig. 4.

ACPD
14, C10055–C10063, 2014

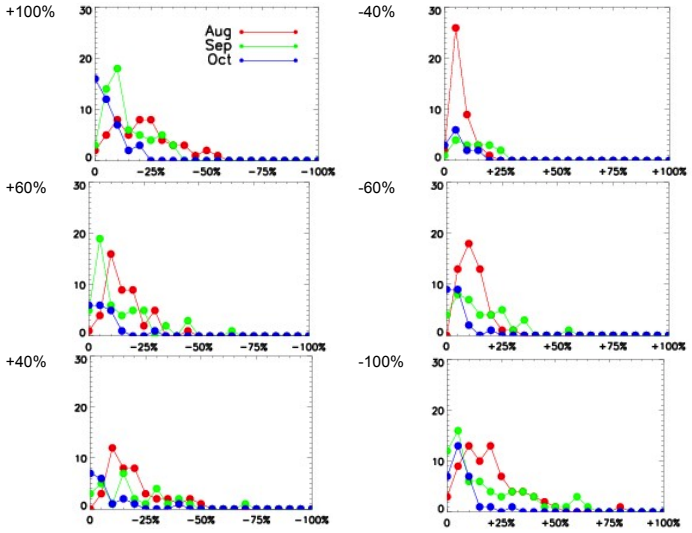

Fig. 5.

ACPD
14, C10055–C10063, 2014