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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Mesoscale convective systems observed during AMMA and their impact on the NO_x and O_3 budget over West Africa" *by* H. Huntrieser et al.

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- We thank Reviewer #1 for the helpful comments to improve our manuscript.

This work seeks to clarify the impact of convective transport and lightning NOx production on trace gas distributions through extensive analysis of two events observed during the AMMA field project. To achieve this, the authors combine lightning observations from LINET, satellite observations of storm evolution, and ECMWF meteorological analyses with aircraft observations from several platforms. The paper, following on the authors' similar analysis of storms observed during several other field campaigns, is very thorough, well reasoned, and clearly explained. I think it would be preferable to

reduce the overall length, if possible, though I can find no obvious areas in need of substantial reduction. Their results from AMMA support previous findings that tropical storms may produce less NOx on a per flash basis than do subtropical and midlatitude storms. This is an important result which will likely contribute to improved parameterizations of lightning NOx production in chemical transport and climate models in the future. In addition, the subject matter should be of great interest to the ACP readership. I recommend publication.

- To slightly reduce the length of the paper, we have cut Fig. 18 and the comments in Sect. 5, since similar results are shown in Figs. 15 and 17.

One area that could benefit from further explanation is the handling of lightning observations during the August 6 MCS (Section 4.2). The authors state that the LINET system was not operational until 11 UTC. Estimates of production per flash are based on the flash rate between 11-12 UTC (when the aircraft sampling ended) – is this correct? Is it possible that flashes prior to 11 UTC contributed to the NOx observed by the aircraft? If the flash rate were larger earlier in the storm (as is likely), how would this impact the production per flash estimate for this storm? The authors have done very well with a limited amount of information, but I think a bit more explanation of this point is required. Also, is there any other source of lightning information that may be used to provide information on the earlier part of the storm – perhaps WWLLN observations?

- We now analysed time series of satellite images and WWLLN data and added this text to the section (Page 22791, Line 6): "The first selected penetration from this case in Table 3 (P5-6) lasted from 10:56-11:14 UTC. For further calculations we used the LINET stroke rate between 11-12 UTC (0.041 strokes s-1). We believe that this number is representative for the selected penetrations in Table 3 (P5-6, P8-9) for several reasons. The satellite images show that the most active phase of the MCS was between midnight and 8 UTC. Between 9-14 UTC the storm slowly decayed. From Fig. 11a it is clear, that the stroke rate was not changing much between 11 and 14 UTC. We therefore do not expect a very different stroke rate at the beginning of the flight between 10-11 UTC, where no LINET stroke measurements were available. In addition, from the position and movement of the storm, we do not expect to observe a lot of aged NO (from older strokes) in the area where the penetrations took place. The analysis of WWLLN data for the region covered by the MCS (11-17° N, 0-6° E) indicate that the WWLLN stroke rate also rapidly decreased in the morning (7-8/ 8-9/ 9-10/ 10-11/ 11-12/ 12-13 UTC: 59/ 53/ 38/ 8/ 11/ 2 strokes h-1). Mainly the stokes between 10-12 UTC (from position and timing) contributed to the NO enhancement observed. Since the WWLLN stroke rate was almost constant between 10-12 UTC, we may assume that the selected LINET stroke rate between 11-12 UTC (0.041 strokes s-1) is representative for our selected penetrations listed in Table 3."

Minor and technical corrections:

P. 22768, Line 7 – Statement about isoprene is awkward – remove or reword.

- Has been removed.

P. 22768, Line 24 – Change 'up to' to 'until'

- Has been corrected.

P. 22771, last line – 'TLL' should be 'TTL'

- Has been corrected.

P. 22772, Line 18 – NOx is generally but not strictly conserved. I would consider rewording for clarity with something like 'During the short timescales of convective transport from the BL to the UT, NOx is generally conserved but not NO or NO2 individually.'

- Has been corrected.

Section 2.2, Paragraph 2 – The background on NOx that comprises most of this paragraph is informative and well written, but I'm not sure that it belongs in the instrumentation section.

- It is difficult to move this brief part to a different or separate subsection. It is too detailed for the introduction. We instead decided to change the title of this subsection to "Airborne instrumentation on Falcon and Geophysica, and some trace gas characteristics".

Figures 3, 7 – Is there a way to identify portions of the flight which where in and out-of cloud or was nearly all the sampling in-cloud? If there is a clear indication, it would be useful to indicate this on the figures (perhaps by shading the background grey) to help separate cloud effects from background mixing ratios.

- These two figures are already quite busy and adding a shade for the in-cloud sections would make them even more unclear. The corresponding satellite images in Figs. 2 and 6 (with the red labels for the penetrations with elevated NO) help the reader to follow where the aircraft penetrated the cloudy regions (same labels as in Figs. 3 and 7). In addition, in Table 2a-b the single penetrations are listed and also if the penetrations were located within or outside the cloudy regions. The flight on 6 August 2006 was almost entirely within clouds. During the transfer to and from the MCS on 15 August 2006 also regions with almost no clouds were penetrated (labelled 1-2 and 7).

- Finally we have added some new references on LNOx: Beirle et al. (2010) to Sect. 1, Barthe et al. (2010) and Yair et al. (2010) to Sect. 7.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 22765, 2010.