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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Medium-range mid-tropospheric transport of ozone and precursors over Africa: two numerical case-studies in dry and wet seasons" *by* B. Sauvage et al.

B. Sauvage et al.

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Response to anonymous Referee 1

(Referee 1) Figures are of good quality but too small.

The figures will be larger in the revised ACP manuscript.

The authors provide a pretty convincing evidence that mesoscale transport could produce the observed features of pollutants distributions. However they did not discuss possible additional mechanisms that could contribute in the ozone concentration above *boundary layer.*

We agree with the Referee. In the revised version we discuss briefly some of those additional mechanisms which can act above the boundary layer whenever relevant, as explained below. Indeed the goal of the present paper is not to describe mechanisms that could contribute in ozone mixing ratio in the free troposphere, even if that would represent an interesting study. Indeed we aim to focus in the better understanding of transport mechanisms leading to ozone enhancements below 3500-4000m. We better clarify in the text that we did not see any influence from the free troposphere into the ozone layers that we study.

Ozone related to lightning could be mixed down from the middle and upper troposphere.

We agree that lightning could potentially create ozone that could be mixed down. However in the present study, this mechanism does not likely to appear, as the lightning activity is located in the opposite hemisphere: in the southern hemisphere during the dry season case study, in the northern hemisphere during the wet season case study, northern to Lagos (http://thunder.msfc.nasa.gov/data/LISbrowse/jul03.html). The trajectories did not show any origin from the middle or the upper troposphere. Moreover, the analysis of the brightness temperature from METEOSAT IR did not show any convective activity along the trajectories path, except for the wet season case study, as already described in the original manuscript. Therefore we add in the revised version a discussion of potential lightning influence for that case study (Section 4.3, paragraph 2 “Additional influence ... mixed down”).

Pollutants could be released into the lower free troposphere during collapse of the boundary layer in the night. Trajectory analysis does not predict concentrations. It would be useful to conduct direct tracer transport simulations using obtained downscaled meteorological fields to proof that observed concentration could be produced by the hypothesized sources.

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EGU

In order to investigate the possible influence of local pollutants in the upper part of the lower troposphere, we have performed tests (not shown) by releasing particles at different times from a 100km x 100km box centered on Lagos between the surface and 500m above. No upward transport above 1000m asl was obtained. The collapse of the boundary layer is a known mechanism of transfer into the free troposphere, but the upward transport cannot exceed in height the maximum (daytime) depth of the boundary layer. The test made here shows that the local boundary layer (L1) does not really develop above 1000m and does not mix into L2. A complementary test was realized with boxes centred to the northeast of Lagos (where fires may occur). It shows on contrary that particles are rapidly uplifted in the ITF area. These particles are thereafter transported by the Harmattan up to layer L2. This clearly confirms distinct origins for L2 and L3 and no interaction between the two layers. During the wet season similar study also showed no influence from the surface, even at night. We clarify those points in the revised version (end of paragraph 6, section 3.1 “Moreover In order to investigate ... L2 and L3”, and section 4.1, last paragraph “As in Sec 3.1 ... air mass”)

Referee’s suggestion to perform tracer simulations to quantify ozone production downwind of sources is interesting but to our opinion, it is out the goal of the present study. We aim to highlight the role of meridional circulation to inject pollutants into the free troposphere, and to point out a possible link to observed ozone mixing ratio downwind. It is out of our goal to quantify the part of ozone coming from the different transport mechanism or photochemical production. This would imply the use of a chemistry transport model. The possibility for such ozone and CO concentrations to form in the lower troposphere within few days has been demonstrated in previous studies (eg., Chatfield and Delany, JGR, 1990, Jonquières et al., JGR, 1998).

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References

Jonquières, I., A. Marenco, A. Maalej, and F. Rohrer, Study of ozone formation and transatlantic transport from biomass burning emissions over West Africa during the airborne Tropospheric Ozone campaigns TROPOZ I and TROPOZ II, J. Geophys. res., 103(D15), 19,059-19,074, 1998.

Chatfield RB, Delany AC, Convection links biomass burning to increased tropical ozone - However, models tend to overpredict O3, JGR (D11): 18473-18488, 1990

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 4673, 2007.