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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Tropospheric ozone production related to West African city emissions during the 2006 wet season AMMA campaign" *by* G. Ancellet et al.

Anonymous Referee #1

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General comments:

In this study, ozone (O3) production around three cities in West African is investigated. Airborne measurements of O3, CO and nitrogen oxide (NOx) are analyzed and simulations using a Lagrangian model, a three-dimensional (3D) mesoscale model, and a chemical box model are conducted. The airborne measurements are valuable. But the values added by the model simulations are very limited. Part of the model setup and some of the assumptions of the model simulations are highly questionable. Thus some of the interpretation of the model results are highly questionable. Most of the XY-plots in the paper are not readable.

Major comments:

1. In the setup of the box chemical model, vertical mixing is neglected. This is not reasonable since turbulence vertical mixing would change the mixing ratios of chemical species significantly in the atmospheric boundary layer. Also it is not reasonable to using constant temperature and water vapor during a 2-day simulation (Even diurnal cycle is not considered). Thus the simulation using the box model does not really help explain the O3 production rate. In Figure 18, the NOx mixing ratio over the downwind area is zero. This is contradictory with the reality and the text. See "The Cotonou plume is related to a significant increase of NOx from 1.5 to 5 ppbv" on page 27155. In reality, the NOx mixing ratio is higher in the downwind area than in the upwind area.

2. The 3D model simulation is just evaluated using 3 profiles, one for wind speed, one for wind direction, and one for relative humidity. I would not agree "the BOLAM simulation of the PBL structure is in a very good agreement with the meteorological observations" without more extensive evaluation. The biomass burning emissions simulation is longtime integration (one month). How can we trust the meteorology simulation over such a longtime integration? How can we trust the tracer dispersion driven by such meteorology simulation without any evaluation?

3. Frequent convection is a key factor of determining O3 production in west Africa. Also the moist convection changes vertical O3 profiles significantly (Grant et al., 2008, Atmospheric Environment). But the paper did not discuss the difference of the convection in terms of frequency and intensity over the three cities at all.

4. Most of the XY-plots in the paper are very hard to read.

Minor comments:

Line 5, page 27136: "significant Ozone production (O3 increase of 40-50 ppbv)" took place in how long time?

"7 km-anthro" is used in the text for a few times. But the resolution of the simulation is

"around 8x8 km".

"Black and red asterisks in Fig. 11" on page 27151. No black asterisk is found in Fig. 11.

On page 27151, the sentence "Close to Lagos high value for emissions are reported, while the overall area encompassing Cotonou and Lagos exhibits weak emissions" does not make sense.

On page 27152, "simulated in the 7 km-anthro simulation at 10, 12 and 14:00UTC above Cotonou" It is better to mention on which day the vertical profiles are shown.

On page 27150, the paper introduced the biomass burning emission simulation at first, then the local anthropogenic emissions simulation. But After that the paper shows the results from the Local anthropogenic missions simulation at first, then the results from the biomass burning emissions simulation. It is not a good sequence.

In Figure 16, the horizontal distribution of biomass burning tracer is shown at 900 hPa, which is in the boundary layer. But the paper mentioned the advection of biomass burning from the Southern Hemisphere is at 3-5km. Does Figure 16 suggest the advection of biomass burning occur in the boundary layer?

What are the VOC species in the box chemical model? The initial values for those VOC species may be important for O3 production.

On page 27152, Line 15, "were" should be "where"

Show Lagos in Figure 1 since it is very important to the O3 production in Cotonou.

Use full words for "0D" when it appears for the first time.

On page 27149 Line 18. "O3 increase of the order of 50 ppbv in two days". What is the O3 value? Is it Daily average O3 or peak O3?

On page 27148, Line 7, "While local ozone deposition and convective influence play

a role in the differences between Niamey and Ouagadougou observations". What is the difference of convection over Niamey and Ouagadougou in terms of intensity and frequency?

Page 27138, Line 17, "O3 and its precursor gases, namely NOx and CO". There are other O3 precursors, for example, VOCs.

References are needed for "numerous mesoscale convective systems (MCSs) can developed over West Africa with a strong impact on vertical mixing of O3 and O3 precursors." on page 27140

Mean O3 profile (total 24) is shown in Figure 2. Deep moist convection can modify tropospheric O3 profile significantly. How many of the O3 profiles were impacted by recent deep convection? and How many were impacted by the advection from SH?

Page 27142, Line 4, "30 June sounding". What is the time of day for the sounding? It is important to explain the O3 profile.

What is "coast line emissions" on page 27143?

Page 27144, Line 15, "ozone depleted" is not appropriate for a O3 level of 35 ppbv.

Page 27144. "there is a significant variability in the CO concentration with 25% of the distribution above 200 ppbv and below 120 ppbv within the PBL. This indicates that the city emission is not large enough to maintain a constant high CO level as observed near the coast". Significant variability in CO does not indicate "the city emission is not large enough".

Page 27144, "Nevertheless flights within polluted plumes occurred as shown by the occurrence of high CO values". How high CO values should be in the "polluted plumes"? What is the threshold value to define a polluted plume?

Page 27145, Line 29. "small variability around 30 ppbv" Actually the variability is larger than that shown in Figure 5 at some levels. So Figure 5 also indicate very few plumes

at Niamey?

Page 27145, Line 16, "on" should be "one"

Page 27146, "Differences in the anthropogenic emissions between Ouagadougou and Niamey should lead to more polluted case studies for the former", why?

Page 27146, "the vegetation cover since the local ozone sink is more efficient to remove O3 over the more vegetated city (Ouagadougou)." What is "the local ozone sink"? deposition or chemical destruction? How do you know? There is no measurement or estimation of the "local ozone sink".

Page 27146, "no particular day with condition favourable to pollution plume formation and ozone production have been recorded." What is the "condition"? meteorology condition or emission? Low O3 variability means either unfavorable meteorological condition or low emission.

Page 27146, What is the reason to pick up the particular levels of "2250m and 3750m"?

Page 27146, "since the significant O3 production in the city plume occurs during a non convective period to reduce mixing and wet removal processes, but following a very active one necessary to increase NOx soil emissions." What reduce "mixing"? what is the "wet removal processes"? wet deposition? Dry deposition may play more important roles than wet deposition to remove O3.

Page 27150, Line 25, the horizontal grid resolution (216oX216o) must be wrong.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 27135, 2010.