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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Emission sources contributing to tropospheric ozone over equatorial Africa during the summer monsoon" *by* I. Bouarar et al.

Anonymous Referee #1

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Review of Bouarar et al.: Emission sources contributing to tropospheric ozone over equatorial Africa during the summer monsoon

This paper analyses potential impact factors on the ozone distribution over Africa during the AMMA period in summer 2006. For this purpose a coupled chemistry climate model (LMDZ_INCA) is used. The model meteorology is driven by ECMWF analysis data and a combination of state of the art emissions is used. The base simulation is evaluated against MOZAIC, AMMA and satellite data from MOPITT and SCIAMACHY. Several sensitivity experiments are performed to estimate the effect of convection and different emission sources on ozone. The authors conclude that African biomass burn-

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Interactive Discussion
Discussion Paper

ing and lightning NOx are the most important factors for ozone production in the middle and upper troposphere. The maximum production is found downwind off the continents. A bit surprising is the fact, that according to the authors soil NOx and biogenic emissions have similar impact on ozone at 240 hPA. They also find a significant contribution from Asia mainly in above 240hPa. The paper is clearly written over most parts and the results are presented properly. It contains some new details about the ozone sources in the tropics and their vertical distribution. The paper can be published after the following points have been adressed

p.13774, l.24 (also p13779, l.20, also. section 5.1) : The effect of switching emissions off versus a sensitivity has been invested in Grewe et al., GMD, 2010. Note that the total sensitivity of ozone to a perturbation of the emission still does not cover the total effect compared to a full tagging scheme.

p.13775, l.15-20. The model resolution of 2.5x3.75 (L19) is relatively coarse when looking at convection. How many levels are below 100 hPA and how many vertical levels represent the TTL or the UT, which is quite important for the later manuscript?

p.13776,l.16: For Africa a special high resolution biomass burning emission data set is used. How does it compare with GFed in terms of global numbers? How does long-range transport of GFed emissions from other parts of the world (in particular Asia) affect the results?

p.13787/13788: The conclusion here is that the CO is overestimated due to an overestimate of JJA BB-emissions in the L3JRC data. How would a further reduced emission affect ozone, which is underestimated in Fig.4b) ? To me it looks as if convection is too strong enhancing CO and reducing ozone compared to MOZAIC. I don't see the consistency of the conclusions from Figure 4a) and 4b). What's the role of transport from emissions other than biomass burning? What's the role of scavenging and potential long range transport of NOx-reservoir species from other source regions? Which process is less realistic in the model: dynamics(i.e. convection), chemistry, or the

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emission data set? How is the occurrence of lightning NOx coupled to the NO_CONV experiment? Does NO_CONV imply much less lightning and LNOX as well?

p.13789, l.25: Comparison is made with MOPITT data, which are carefully used applying the kernel to model data which have the correct overpassing time. Nontheless the model overestimates the CO column compared to MOPITT. Which role plays the occurrence of clouds? Are the MOPITT data mainly based on cloud free conditions? If so, can this explain systematically lower CO in the observations (due to biased obeservations towards cloud free conditions)? Is any statement possible about the vertical CO distribution or the relation between model and MOPITT in the UT? Similar for NO2 - what's the role of clouds?

p.13792,l.10: Is it the transport of soil NOx or the transport of soil NOx induced ozone?

p.13797, l.6: add 'global' ozone change

Technical: In general for the difference plots: Please indicate in the Figure captions the differences as e.g. Fig 8: KE_AMMA - BIO_red. It facilitates reading the differences.

Fig13. Wrong y-axis label xor numbers

It would also be good to have the integrated emission totals for the L3JRC data as monthly means in comparison to the GFed emissions - just a table of CO and NOx.

References: Grewe, V., Tsati, E., Hoor, P., On the attribution of contributions of atmospheric trace gases to emissions in atmospheric model applications, Geosci. Model Dev., 3, 487-499, 2010.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 13769, 2011.