

Interactive comment on “Interactions of Atmospheric Gases and Aerosols with the Monsoon Dynamics over the Sudano-Guinean region during AMMA” by Adrien Deroubaix et al.

Anonymous Referee #2

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General Comments:

This paper looks at the contribution of different emissions sources to CO and PM_{2.5} over W. Africa and the meteorological conditions that influence the transport of the pollutants within this region. It is a model study using a WRF coupled to CHIMERE and evaluated using measurements made during the AMMA project in 2006. It is the impact of the meteorological conditions on pollution concentrations particularly on the coastal region where the majority of people live that provides novel insight that is worthy of publication. I do have a few concerns that I would like to see addressed before publication.

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Specific Comments:

It is not clear to me why in section 3.3, the model meridional simulation of CO and PM_{2.5} is evaluated against just two flights the on consecutive days (13-14 June), during which an MCS passes through the area (section 3.3.1). On the back of this the model is then used to quantify the modelled pollution source apportionment on a monthly basis. Why not evaluate the model over the whole month? There were flights on other days and with other aircraft. There are several papers published from the AMMA campaign that could have been used to help with this evaluation – see Reeves et al (2010) (www.atmos-chem-phys.net/10/7575/2010/) that gives an overview of the chemical and aerosol characterisation and references therein. Satellite data could also be used for the evaluation. This would also help to evaluate the transport of biomass burning plumes into the region from south of the aircraft flight tracks.

How is the source apportionment (Section 3.3.1) determined? Are separate CO tracers used for the background, anthropogenic and biomass burning? How is this done for PM_{2.5}, in particular considering how the aerosol scheme works? How is the formation of SOA considered? What about mixed aerosols? One of the main scientific questions addressed in this paper is the contribution of different sources to pollutant concentrations, so it is essential that a clear description of the methodology for determining this is included in the paper. Much of the analysis in the paper focuses on anth-PM_{2.5} so it must be clear how this is defined.

Section 4.2.2. I really do not understand the conclusions here. In Figure 7, surely a and b are the wrong way around, with the top plot having the 1 a.u. contour at around 7N near Cotonou and the bottom plot having it at 14N near Niamey? Perhaps I am getting muddled by this figure, but it seems extremely odd that the ratio of the coastal to Sahelian tracer is greater in the Sahelian region, especially since the tracer experiment uses arbitrary units and so does not consider the relative strengths of the tracer emissions in each region. The clarity of the discussion could be improved by attention to the English, but I think there is something scientifically wrong here.

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P 2, l 22-24: Several values are given for high concentrations of pollutants in these 3 lines. It would be helpful to give the time averages over which these measurements were made as the context of this paragraph is to compare them with the air quality standards which are for specified periods of exposure.

P 4, l 24-25: I'd like to see more details on how WRF is coupled to CHIMERE. Is the CHIMERE transport used or just the chemistry? Time steps for physical processes and chemistry?

P 5, l 24: It would be good to show plots of the TRMM and GPCP data to demonstrate the good agreement.

P 6, l 3-8: Looking at Fig. 2, it seems to me that the precipitation is focused at 2N through much of June and that it is only until mid-late June that it shifts to more to 5N. This is not consistent with the text that says the pre-onset occurs in May.

P 9, l 30: The high CO concentrations at the coast are not so continuous in late June and July.

P 10, l 5-8: Please explain more clearly how precipitation/convection impacts surface CO concentrations. How does it affect the vertical distribution?

P 10, l 15-16: A can't make out any great difference between the pattern at 12N and 13N.

P 12, l 27: Are diurnal patterns included in the emission inventories used?

P 12, l 29-31: In Fig. 8 some of the pollution over the sea on the 10-11 June in the Hovmuller plot appears to progress northwards with time (i.e. bottom left towards top right) rather than be transported out to sea from the land. Fig. 9 suggests it may be coming from other cities further to the south.

P 13, l 33: How can you be sure that the plumes are "overlying" and not mixed?

The English needs to be improved. I have listed some places where the understanding

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is not clear or incorrect because of the English, but there are many minor corrections that need to be made (e.g. the appropriate use of "the" and "a", use of singular and plural) that I have not listed. Technical Comments:

Ensure the initial letters of "Guinean Gulf" are in uppercase, here and throughout the paper.

P 1, l 5-6: It needs to be clear what the 38% relates to. 38% of PM_{2.5}?

P 1, l 9-10: It is not clear. Are the pollutants emitted near the coast concentrated in the Sahel?

P 1, l 11: "Refining the analysis" – reword the English. Suggest "Focusing the analysis"

P 1, l 13: "overlay" each other?

P 1, l 13: "high pollution level" is ambiguous. High concentrations? High altitude?

P 2, l 2: "washout the atmosphere" change to "wash pollutants out of the atmosphere"

P 2, l 4: "air pollution". Are natural components of the atmosphere pollutants? E.g. Sea salt aerosols?

P 2, l 7: "in megacities" should be "from megacities".

P 2, l 31: "since the last decade". The English is not clear. Do you mean "since" or "during". Note that the main AMMA campaign was in 2006, i.e. more than a decade ago.

P 3, l 13: "This article is dedicated to the pollutants transport over the Guinean Gulf coastal region and focuses on two major pollutant concentrations:". Reword the English, "This article focuses on transport of pollutants over the Guinean Gulf coastal region, in particular on:"

P 3, l 15: Replace "have both an" with "both have a".

P 3, l 17: Replace "pollutants in the" with "pollutants to the".

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P 3, l 23: Replace “refines spatially” with “focuses on”.

P 3, l 27: It would be useful to provide a figure showing the 2 nested domains.

P 4, l 6: Replace “hourly interpolated” with “interpolated hourly”.

P 4, l 8: “better” than what?

P 4, l 27-28: Replace “The anthropogenic emissions are estimated using the HTAP v2 (Hemispheric Transport of Air Pollution) annual totals for the year 2010 by the EDGAR Team,” with “The anthropogenic emissions are estimated by the EDGAR Team using the HTAP v2 (Hemispheric Transport of Air Pollution) annual totals for the year 2010,”

P 4, l 31-32: “Taking into account vegetation fires emission fluxes is of primary importance to simulate West African pollution (Giglio et al., 2006).”- The English needs improving.

P 4, l 31 – P5, l2: Be consistent with terms and their combinations: “fire”, “vegetation”, “biomass burning”. How were the two parts split?

P 5, l 4: “a new global soil and surface datasets” – singular or plural?

P 5, l 4: “a satellite-derived aeolian roughness length data” – singular or plural?

P 5, l 14-15: “first analyze and quantify the temporal variability of the pollutants concentrations modeled in the urbanized areas along the Guinean Gulf coast during the whole AMMA-SOP1 period (Redelsperger et al., 2006). First” There are two “firsts” which is confusing. It states that the temporal variability of the pollutants will be analysed, but in the rest of the paragraph I can only see mention of AOD. What about any other pollutants?

P 5, l 29: Replace “interactions constituted” by “interactions, which are made up”.

P 6, l 27: Replace “lead” with “leads”.

P 7, l 5-6: English needs improving.

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P 7, l 28: What is meant by “a South-North gradient is expected moving closer to the Sahara”?

P 7, l 31 and P8, l 4: What is meant by “a gap of concentration”?

P 7, l 7: To test if the model reproduces the MCS, why not compare modelled meteorological parameters with observed – e.g. satellite precipitation.

P 7, l 8: Replace “not realistic” with “unrealistic”.

P 7, l 9: Why “Nevertheless”?

P 8, l 31: Presumably by “vegetation emissions” you mean biomass burning rather than biogenic. This needs to be clear and correct throughout the paper.

P 8, l 33-34 and P 9, l 5 and 10: Units of ppb should be microg / m-3.

P 10, l 10: Why “more important”?

P 10, l 11: What “increase”? The English in this sentence needs improving. Consider splitting it in two.

P 10, l 13: A frequency has units of 1/time. Do you mean a periodicity close to 2 weeks?

P 10, l 14: A wouldn't call these features plumes as they are a characteristic of a Hovmuller plot rather than a pollution plume.

P 11, l 19: anti-clockwise?

P 12, l 25: Replace “derives” with “are transported”.

P 14, l 11-12: Low and high anthropogenic pollution where? Contonou?

P 15, l 14: “Figure ??”, 11.

Fig. 2. Caption “regional domain” should be replaced by “regional model domain”.

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Fig. 3. The legend only says “anthr” but the captions says “anthropogenic, biogenic and mineral dust”. Is the red line the sum of “anthropogenic, biogenic and mineral dust” and “biomass burning emissions”?

Fig. 6 caption: what PM2.5 mass density is the light orange line meant to be? Shading should be lines.

Fig. 7 caption: Shading should be lines. It is not clear if one line is white or both are yellow.

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