Atmos. Chem. Phys. Discuss., 7, S9353–S9358, 2008
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Tracing biomass burning plumes from the Southern Hemisphere during the AMMA 2006 wet season experiment" *by* C. H. Mari et al.

C. H. Mari et al.

Received and published: 21 February 2008

We would like to thank the referee for his/her very constructive remarks which helped us to clarify the objectives of the paper and improve the scientific analysis.

We adress each point of the reviewer comments below:

1. *In figure 1, why are you averaging over two different longitude ranges for the different periods? Why are you averaging over the ocean areas in the Southern hemisphere?*

   Figure 1 in the paper shows averaged zonal wind speed for two longitude ranges but for exactly the same period (25 July to 31 August) as stated in the legend and in section 2 - line 20. Both figures show the cross section from 30°S to 30°N. From this figure, it can be concluded that the AEJ-S is well defined over the continent (eastern sector) over the summer month. Its oceanic branch (western sector in Figure 1) is less marked during the same period. The following text has been added to Section 2:

" The AEJ-S is more pronounced in the eastern (continental) sector. AEJ-S core speed lies between 4-6 ms^{-1} **over the continent**. Hence it is weaker than the AEJ-N. Its position if around 5S and 700 mb. **The oceanic part of the AEJ-S has a less marked signature on a monthly mean basis.** The existence (...)"

2. *It is not clear why there should be a jet in the southern hemisphere. First, it would seem to me that the surface temperature gradient would put the AEJ-S at much lower latitudes over land points. A plot of 925 hPA temperatures would confirm stronger temperature gradients in more southerly latitudes. Second, if you look at your averaging of longitude it is completely out over the ocean. Is the AEJ-S at this longitude an extension of what is happening over land?*

   The 925 hPa temperature was plotted for the entire period (25 July - 31 August). The figure 1 (ftp://ftp.aero.obs-mip.fr/pub/MOZAIC/MARI/acpd-2007-0443-fig01-review-only.jpg) shows the surface temperature gradient over the continent between 5S and the equator. This picture is consistent with the location of the core of the AEJ-S over the continent (see Figure 2 of the paper).

   The objective of the paper is to look at the correlations between the intrusions of southern hemispheric fires to the north over the Gulf of Guinea and the oceanic branch of the AEJ-S. To achieve this goal, we concentrate our analysis of the transport over the ocean especially during the active phases of the AEJ-S. We interpret the relatively high zonal wind speed over the ocean as the oceanic branch of the AEJ-S.

3. *This jet is rather weak. It is clear what is responsible for its variability? In fact,*

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is it influenced by the convection which propagates from east to west on a daily basis?

The goal of this paper is not to explain the origin of the AEJ-S variability. This question would certainly deserve a complete separate study with different tools as the ones used here. A eof analysis over several years for example would be of great help to answer this question. The impact of the convection could be one possibility. It is also possible that the "respiration" of the subtropical anticyclone explains part of the variability.

The following text has been added to the conclusion: "This study clearly emphasizes the role of the AEJ-S in the transport of the southern hemispheric biomass burning plumes during the summer wet-season. **The origins of the intraseasonal variability of the AEJ-S is an open question that deserves a comprehensive study over a larger period**."

4. *Is the break in the AEJ-S linked to deep convection? Could you get satellite data to confirm that that this is the case? Daily OLR should do the trick. What is the mean flow during the break.*

   The figure ftp://ftp.aero.obs-mip.fr/pub/MOZAIC/MARI/acpd-2007-0443-fig02-review-only.jpg show the OLR during the two active phases and the break phase. During the break phase, convection activity seems to be more intense but remains north of 5N similar to the first active phase. Interestingly, the second active phase in August is characterized by a southward propagation of the convective activity (convection reaches 10S). The increased convection does not seem to be sufficient to limit the AEJ-S activity during this period. The link between deep convection and the phases of the AEJ-S is not straightforward and would deserve a more detailed analysis.

5. *Based on your study, the active AEJ-S is responsible for northward transport. Could you show a horizontal plot of the average flow (based on ECMWF model*

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for example) during AEJ break and AEJ-S Active. It would help the reader to understand the flow patterns.

Following the reviewer recommandation, horizontal plots of the averaged tracer plumes during the three AEJ-S phases will be added to the new version of the paper. The figure ftp://ftp.aero.obs-mip.fr/pub/MOZAIC/MARI/acpd-2007-0443-fig03-review-only.jpg (Figure 5 in the new version of the paper) clearly shows the different transport pathways during the active phases (westward propagation over the Gulf of Guinea) and break phases (accumulation of fire tracers over the continent, no export over the ocean).

6. *Why did you choose to do averaging over the ocean entirely for the tracer (Figure 4)? I would expect SE flow patterns over the ocean which would transport fire emissions to the Northeast.* The paper concentrates on the western sector where the AMMA campaign took place. The preferred pathway for the intrusions of southern hemispheric fires over the Gulf of Guinea and the AMMA region was through the oceanic branch of the AEJ-S. This analysis also shows that at higher levels, the main pathway for advection of fire pollutants is from an east flow over the continent after the pollutants get vented by the convection over central Africa during the AEJ-S break phase.

   There is indeed a SE component of the flow in the lower troposphere. However the north-eastward propagation of fire emissions is limited by the AEJ-N.

7. *Does the FLEXPART model explain the low ozone signal at 2 km based on the ozonesondes in Figure 5. It is very well mixed each day up to 2 km but up to 4 km on August 17th (not consistent with the FLEXPART model).*

   The legend of Figure 4 needs to be switched and read as follow: "Ozone mixing ratios measured at Cotonou (6.21N, 2.23E) in ppmv on 25 July (solid line), 3 August (***** dashed line *****) and 17 August (***** dotted line *****)".

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So the picture is now consistent with (1) the AEJ-S break phase corresponding to higher mixing boundary layer on 3 August and (2) ozone maxima at 3 km altitude on 25 July and 17 August during the active phase.

8. *You show the tracer reaching 12 km during the AEJ-S break. Please explain what is happening. Do you see a signal in troposphere ozone to confirm that this is the case?*

   During the AEJ-S break phase, westward advection is inhibited. Fire pollutants remain trapped over the continent. The probability that these pollutants reach the continental convective region northward increases. Injection of tracer in the upper troposphere is thus favored during this period. Figure 12 is described in Section 6 (Discussion).

   The last figure ftp://ftp.aero.obs-mip.fr/pub/MOZAIC/MARI/acpd-2007-0443-fig04-review-only.jpg shows the ozone profiles measured during the AMMA SOP2_a2 period at Cotonou. The ozone profile on 3 August (break phase) shows a peak at 300 hPa but ozone peaks are also observed on profiles during the active phases. The ozone in the upper troposphere over West Africa has several origins and it is not difficult to relate the maxima only to the southern hemispheric fires. In particular, at this altitude, the impact of long-range transport from Asia (see Barret et al., ACPD, 2008) or the middle east may overwhelme the sporadic impact of southern hemispheric fires.

Figure 1: (acpd-2007-0443-fig01-review-only.jpg)
Caption: Mean temperature in K at 925hPa from the ECMWF analysis from 25 July and 31 August

Figure 2: (acpd-2007-0443-fig02-review-only.jpg)
Caption: NOAA OLR in W/m2 averaged from (right) 25 July to 2 August (AEJ-S active

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phase), (middle) 3 August to 8 August (AEJ-S break phase), (left) 9 August to 31 August (AEJ-S active phase)

Figure 3: (acpd-2007-0443-fig03-review-only)
Caption: Fire passive tracer concentration (ng/m3) at 3000 m, averaged between (left) 25 July and 02 August, (middle) 03 August and 08 August and (right) 09 August and 31 August.

Figure 4: (acpd-2007-0443-fig04-review-only)
Caption: Ozone mixing ratios measured at Cotonou in ppmv (Thouret et al.,ACPD, in preparation.)

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 17339, 2007.