

***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.***

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In this study Sauvage and co-authors describe the dynamical processes that determine the ozone concentrations in the lower troposphere over Lagos, Nigeria, in the dry and wet season. As case studies two flights were selected from the MOZAIC database, descending at Lagos airport on 30 January 2002 resp. on 14 July 2003. For each case, the observed vertical profiles of ozone and carbon monoxide are discussed in relation to the observed dynamical characteristics of the different layers. The origins of the air masses with enhanced levels of ozone are identified on the basis of trajectory

calculations for the preceding four days with the non-hydrostatic meso-scale model MesoNH.

In a previous paper (2005), Sauvage et al. presented similar back-trajectory calculations for a variety of locations including Lagos, using winds from ECMWF analyses (6-hourly as well as monthly mean). The transport routes identified in that paper are qualitatively similar to those described in the present paper. The new aspects of this study are the use of a meso-scale model and the conclusion that there is a line of preferred location for air masses containing ozone precursors from fires to be uplifted into the lower free troposphere.

The presented analysis is sound and clearly described. As a general comment, I think the authors should better motivate this study in the context of the work published in 2005. What is to be gained by using a meso-scale model rather than ECMWF analyses? I have the impression that the calculated back-trajectories are qualitatively similar, but give rather different transport time scales. To indicate the robustness and limitations of their calculations, a more quantitative comparison should be included. The paper should be considered for publication in ACP, after the authors have addressed these points of criticism and the following specific comments:

1. As indicated in Figs. 3 and 9, there are large differences between the wind profiles over Lagos simulated by MesoNH and observed by the MOZAIC flights, especially during the monsoon season. Also, there are large differences between the wind speeds simulated with MesoNH and analyzed by ECMWF (Figs. 2 and 8). From the plots shown it remains unclear if MesoNH performs better than the ECMWF analyses. One would expect that MesoNH is able to resolve more of the fine-scale dynamical processes. However, the ECMWF winds are constrained by assimilation. How do the ECMWF analyses compare with the measurements in Figs. 3 and 9?

2. The back-trajectories are initialized by ECMWF analyses at 1 resp. 2.5 h after the time of measurement. How does the initialization affect the calculated trajectories?

Given that MesoNH is able to resolve processes at finer scales, this apparent advantage is effectively lost for the early part of the trajectories. At least in some of the trajectories (especially in those labeled Group 1 in Fig. 10), uplift takes place right from the start. Does this mean that for those trajectories the relevant transport processes are actually prescribed by the ECMWF analyses? Please clarify in the text.

3. To obtain realistic trajectories for particular cases, ideally one would like to apply the initial condition and constrain the model by data assimilation. Can the authors clarify why they have not done so and why they think this is not necessary? A statement about this should be included in the text.

4. The back-trajectory calculations presented by Sauvage et al. (2005) do not account for convection and diffusion. Are these processes represented in the trajectories calculated online with MesoNH? Please specify in the text of Section 2.

5. The peak in the African Easterly Jet observed over Lagos at 2300 m in the January case is at the low side of the range given in the 2005 paper (550-750 hPa, p. 319). Please explain why this is the case.

6. The measured ozone profile shown in Fig. 1 shows an extra peak in the upper part of the AEJ layer (L3), which is not present in the monthly mean profile shown in Fig. 5 of the 2005 paper. In fact, in that paper (p. 320) it was written that the ozone concentrations within the AEJ layer decrease with altitude. Can the authors include an explanation for this discrepancy?

7. In Fig. 2 the wind fields are shown at 3000 m. This is actually exactly the height at which the wind speed over Lagos shows a sharp drop (Fig. 3). Can something be said about the height sensitivity of the results presented in Fig. 2 over other regions?

8. To what extent are the differences in the modeled and observed wind profiles over Lagos (Fig. 3 and 9) related to spatial and temporal variability that is not well captured or to systematic biases in the model?

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9. The circulation pattern shown in Fig. 6 indicates that the AEJ at 22 E is located to the south of the Harmattan. The situation is different over Lagos, where the AEJ is located above the Harmattan. Please explain in the text how this can be understood in relation to the location of the ITF.

10. As explained in the 2005 paper, during the wet season two different situations may occur that lead to qualitatively different ozone distributions over Lagos. The profile measured on 14 July 2003 is of the polluted type. However, the ozone peak presented in Fig. 7 is much higher than the JJA average profile presented in Fig. 15a of the 2005 paper, which also corresponds to polluted situations. Can the authors give an explanation why this is the case?

11. According to the 2005 paper, more than 8 days are necessary to transport air masses from the regions of fires to the Gulf of Guinea during the wet season (p. 326). However, the trajectory calculations presented in the present paper go back only 4 days. Why would this be sufficient then?

12. In Fig. 12 data are shown at four different height levels. I find this rather confusing and would prefer to see the same levels as in Fig. 5.

The remaining points are minor comments or merely technical corrections:

13. p. 4674, l. 6: Change "upper-part" to "upper part"

14. p. 4675, l. 5: Change "radiations" to "radiation"

15. p. 4675, l. 6-7: Write "(Jonquieres et al., 1998)"

16. p. 4675, l. 8: Remove "Chapman and Hall, New York,"

17. p. 4675, l. 9: Change "forest" to "forests"

18. p. 4675, l. 13: Change "During TRACE-A campaign" to "During the TRACE-A campaign"

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19. p. 4675, l. 15: Write "the Indian Ocean"
20. p. 4675, l. 16: Replace "prominent"
21. p. 4675, l. 21: Change to "northern-hemispheric"
22. p. 4675, l. 22: Correct "constrast"
23. p. 4675, l. 24: Change to "south-westerly"
24. p. 4676, l. 3: Change "responsible of" to "responsible for"
25. p. 4676, l. 8-9: Include "the" before "dry season" and "monsoon season"
26. p. 4676, l. 4676: Use consistent spelling throughout the paper; write "meso-scale" as in abstract
27. p. 4677, l. 1: Change "prognostic value" to "prognostic variable"
28. p. 4677, l. 5: Use consistent spelling throughout the paper; write "1-D" as on previous page
29. p. 4677, l. 10: Include space before "(see also"
30. p. 4677, l. 23: Change "wind direction and strength" to "wind speed and direction"
31. p. 4678, l. 2: Change "mixing-ratio" to "mixing ratio". Also on p. 4678, l. 2 and l. 13, and in the captions to Figs. 1 and 7.
32. p. 4678, l. 2: Shouldn't this be 800-1400 ppbv?
33. p. 4678, l. 6: The wind speed also drops to zero. Is this real of because rapidly changing direction?
34. p. 4678, l. 8: Change "north to" to "northerly to"
35. p. 4678, l. 10: Shouldn't 600 be 400 or 500? Also in l. 24
36. p. 4678, l. 12: Remove punctuation after "a.s.l." Also in l. 13

37. p. 4678, l. 12: Change "a wind easterly jet" to "an easterly jet"
38. p. 4678, l. 17: Rephrase "in monthly average"
39. p. 4679, l. 1-2: Change ". In particular" to ", in particular". Remove question mark
40. p. 4679, l. 7: Change "at it will be" to "as will be". Change "now" to "in the following section"
41. p. 4679, l. 13: Change "represents" to "presents"
42. p. 4679, l. 14: Remove "(+102 h)"
43. p. 4679, l. 14-15: Remove "(AEJ)". Change "The dynamical structure" to "The qualitative dynamical structure of the AEJ"
44. p. 4679, l. 16: Change "higher" to "up to a factor 2 higher"
45. p. 4680, l. 3: Change "investigate" to "qualitatively investigate"
46. p. 4680, l. 6: Change "bunch" to "set". Also on p. 4681, l. 26
47. p. 4680, l. 11: Change "uplifted of" to "uplifted by"
48. p. 4680, l. 19: Change "parcel" to "parcels"
49. p. 4680, l. 25: Change "336 K" to "= 336 K"
50. p. 4681, l. 4: Change "meridian" to "meridional". Also on p. 4685, l. 7
51. p. 4681, l. 6-7: By which factor is the vertical component blown up ?
52. p. 4681, l. 9-10: Change "dipolar line ascent/subsidence depicted" to "dipolar ascent/subsidence regions depicted". Change "corresponds" to "correspond"
53. p. 4681, l. 11: Change "highlights" to "highlight"
54. p. 4681, l. 12: Change to "to a surface gradient"

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55. p. 4681, l. 20-21: Write "by Thorncroft and Blackburn (1999)" and "by Parker et al. (2005)"
56. p. 4681, l. 23: Correct "thiner" to "thinner"
57. p. 4682, l. 18: Write "south-westerly" for consistency
58. p. 4682, l. 23: Correct "plaform" to "platform". What about other local sources?
59. p. 4683, l. 3: Change "flux" to "wind speed"
60. p. 4683, l. 16: Change "some overestimation" to "a significant overestimation"
61. p. 4684, l. 6: Correct "analized". Change "wind-fields" to "wind fields"
62. p. 4684, l. 15: Change "occurences" to "occurrences"
63. p. 4684, l. 20: Use consistent spelling for "air masses" throughout the paper
64. p. 4684, l. 21: Rephrase "are under consideration now"
65. p. 4685, l. 12: Correct "souhwards" to "southwards"
66. p. 4685, l. 17: Correct "impige" to "impinge". Change to "the northern hemisphere"
67. p. 4685, l. 20: Correct "adjustement" to "adjustment"
68. p. 4685, l. 24: What is the meaning of "meso-alpha"? Change to "meso-scale"?
69. p. 4685, l. 24: Use consistent spelling: "MesoNH" or "MESO-NH"?
70. p. 4686, l. 1: Change "upper-part" to "upper part"
71. p. 4686, l. 1: Change "To the purpose" to "For that purpose"
72. p. 4686, l. 6: Change "good agreement" to "good qualitative agreement"
73. p. 4686, l. 10: Correct "carbone" to "carbon"
74. p. 4686, l. 15: Change "eachother" to "each other"

75. p. 4686, l. 16: Change to "the equator"
76. p. 4686, l. 17: Change to "few hundred kilometres"
77. p. 4686, l. 18: Change to "(Burpee, 1975; Janicot, 1993)"
78. p. 4686, l. 27: Change to "Inter Tropical"
79. p. 4687, l. 1: Capitalize "Harmattan"
80. p. 4687, l. 7: Write "south-easterly" for consistency
81. p. 4687, l. 8: What does "surmounts" mean in this context? Please reformulate
82. p. 4687, l. 9: Change "the ones" to "those"
83. p. 4687, l. 11: Change "base" to "basis"
84. p. 4687, l. 23: Adapt reference as this is a chapter in a book. Use "in"
85. p. 4688, l. 6: Change "Geoph." to "Geophys." Also on p. 4688, l. 23 and 32, and p. 4689, l. 4.
86. p. 4688, l. 9: Correct reference
87. p. 4688, l. 26: Include space between "Meteor." and "Monogr."
88. p. 4689, l. 2: Abbreviate journal reference
89. p. 4689, l. 5: Correct "precessus" to "processes"
90. p. 4690, caption to Fig. 1: Mention that the angle of the wind is zero for northerly winds and + 180 for southerly winds. Also in Fig. 7. Mention that ozone and relative humidity share the same axis.
91. p. 4691, caption to Fig. 2: Change "wind modulus" to "wind speed". Also in Fig. 8.
92. p. 4693, caption to Fig. 4: Mention the start time as well. Also in Fig. 10.

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93. p. 4694, caption to Fig. 5: Do I understand correctly that the dashed line indicates the 336-K level? If so, please mention this in the caption.

94. p. 4695, caption to Fig. 6: Change "total-wind speed" in "total wind speed". Also in Fig. 13.

95: p. 4703, Fig. 14: This Figure is very illuminating.

96: p. 4674, Title: Change "case-studies" to "case studies"

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