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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Friagem Event in Central Amazon and its Influence on Micrometeorological Variables and Atmospheric Chemistry" *by* Guilherme F. Camarinha-Neto et al.

Anonymous Referee #2

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General comments The manuscript studies a Friagem event during July 9 – 11, 2014 in the central Amazon region and its influences on the micrometeorology variables, local circulation, as well as the trace gas concentrations. The investigation of a cold front in the central Amazon is a relevant subject for research in current days. Using the reanalysis and the satellite data, the manuscript demonstrates the propagation of the cold front and the convection on Jul 11 2014. The second main component of the paper is to understand the event mechanistically and its influences with the local circulation by simulating the cold front. The third component is to explore the influences of this front on the temperature and the trace gas concentrations. I trust most of the results regarding the meteorological part such as the occurrence of the cold front and its link

to the convection on Jul 11. I feel the weaknesses of the manuscript is the depth of discussion and the interpretation of the chemistry part.

The cold front has a lifetime of 3∼ 5 days as presented in the manuscript, while O3 has a much shorter lifetime. It is tricky to quantitively define the influences of the cold front on O3 directly due to their different timescales. Specifically, the authors suggest that the cold pool arrives at ATTO on July 9-11. However, the O3 mixing ratios are affected on the 9th and 11th by convective systems, not on the 10th. To me the O3 concentrations are closely related to the convective systems not the cold pool necessarily. In addition, the dry deposition and vertical mixing are heavily speculated to play a part in the O3 concentrations without actually being estimated.

The general features of the cold front are clearly described in the manuscript such as the temperature drops and the trade wind is weakened, which accounts for the majority of the manuscript. However, the understanding and discussion of its mechanism is lacking. For example, it is not clear how the cold front induces the convection on July 11 that affects the O3, and thus it's still unclear to what extent Friagem affects O3 in general without knowing its influences on inducing convections. In addition, the cold pool and the subsequent weakened vertical mixing are not well demonstrated because of the lack of vertical profiles of meteorological variables. I believe these can be fixed by further exploring the model results.

Major comments 1. Line 145: Figure 3 suggest that the changes in temperature are not that significant for Manaus and ATTO, somewhere within 2 degrees. 2. Figure 4: Is the same data in Fig. 4 as in Fig. 3a and 3f? I wouldn't show the same data twice. 3. Line 160 "carries air rich in O3": What is (are) the source(s) of the O3? 4. Line 166-167: The chemical reactions with terpenes emitted by the forest might be important for O3 loss too. The estimate of the lifetime of the O3, which is a function of dry deposition and chemical reactions is needed for this argument "As O3 deposition prevails, a net loss of ozone is expected during transport under conditions of limited photochemical production". 5. Line 178-179: How the maximum air temperature is defined here?

Seems like it is part of the diurnal cycles, which to me is not an appropriate metric for evaluating the intensity of the Friagem. 6. Line 213-215: not clear. Clarify. 7. Line 228: Any explanations for the decreases in O3? 8. Line 238-241: “did not result in an increase of near surface O3”. I don’t necessarily agree with this. I think there is an increase in O3 from roughly 6 ppbv to 10 ppbv. To validate if this increase is due to the convection, you can calculate the virtual potential temperature as in Gerken et al. (2016). 9. Line 247 and 262: The vertical mixing can be evaluated by the vertical profiles of the virtual potential temperature. 10. Figure 13: Why the temperature at 24.4 m is used? It is within the canopy if I understand correctly, which I think would be very different (presumably lower) from above-canopy temperature. 11. How well the surface layer is represented by the JULES-CCATT-BRAMS model in general? How about in this study? Any comparisons between the modelled and the observations to evaluate the fidelity of the model for surface layer? 12. Line 318-319: The suppressed vertical mixing might play a part in the decreased O3 mixing ratios, but it’s not the only or main reason here.

Minor comments 1. Line 66: I’d cite more relevant studies regarding O3 at the T3 site. 2. Line 67: I’d point out the minimal anthropogenic influences at the ZF2 site to contrast the other sites. 3. Table 1: What is the canopy height at ATTO site? 4. Figure 7: I’d present the data in the order of Porto Velho, Manaus, and ATTO. 5. Line 207: There are some editorial/technical issues to be fixed. For example, the parentheses are missing for “Fig. 9”.

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