

Comment on acp-2020-1322

Anonymous Referee #1

Referee comment on "Exploring the elevated water vapor signal associated with the free-tropospheric biomass burning plume over the southeast Atlantic Ocean" by Kristina Pistone et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-1322-RC1>, 2021

The manuscript titled "Exploring the elevated water vapor signal associated with the free-tropospheric biomass burning plume over the southeast Atlantic Ocean" by Kristina Pistone and co-authors investigated the association of CO-q with ORACLES aircraft data over SEA ocean. They have also analyzed the reanalysis and model simulations to understand the meteorological and dynamical dependence of BB plume-water vapour relationship. This manuscript is well written and scientifically sound. I recommend the publication of this manuscript in ACP.

The explanation for the source of water vapour in the continental plume and its close association with BB CO and aerosols is not adequate. Since reanalysis and model results also showed similar variabilities, this could be of a meteorological coincidence rather than direct emissions. But why such a strong association exist between CO and q is not yet clear and needs to be explained in detail. Is there any study on source tagging or isotopic measurements of water vapour and aerosols over SEA?

Authors discussed the influence of boundary layer evolution over land on the vertical transport of CO and water vapour over the continents. I could not find further quantitative supporting information on the boundary layer parameters (boundary layer height, fluxes: SHF and LHF etc) to supplement the arguments. Small write-up on the general boundary layer features and its diurnal structure during the BB events could be useful.

The year-to-year variability of CO-q relationship is worth noting. Authors mentioned the airmass history over the BB regions, but more information is required on this point. Whether airmass pattern shows significant difference between 2016, 2017 and 2018? Notwithstanding the variability in time and meteorological conditions, what about the CO-q association for co-located measurements made during 2016, 2017 and 2018? Whether re-analysis and model simulations also depict weak association during 2017 and 2018?

Section 4.1 analyze the isentropic and kinematic airmass back trajectories using HYSPLIT. Though authors made broad comments on the usefulness and issues of back trajectory analysis, this section did not add more to the association of CO-q. Page 32, Line 1-4: This point is interesting, but needs more clarity and supporting evidence.

There are several studies discussed the radiative implications of aerosols on water vapor and diurnal evolution of boundary layer over the continental locations. How does BB aerosols influence the CO-q association? I wonder whether diabatic heating due to absorbing aerosols has any effect on the elevated layers of water vapour. Moreover, photochemical oxidations and chemical reactions involving CH₄ and OH can also affect the concentration of CO and water vapour. Though the strength of these mechanisms may not be adequate enough to explain the observed CO-q association, it is better to mention these possibilities in the discussion for the sake of completion.

Figure 2 is interesting. Authors mentioned that the humidity datasets (aircraft, COMA, WISPER) differ for measurements within the PBL and rapidly changing aircraft conditions. I still not able to understand why only PBL humidity measured from the three instruments differ? What is the problem with PBL humidity and why aircraft is more stable (fewer ascents/descents) in the free troposphere compared to PBL. What is the rationale for omitting the PBL data is not clear? Is it possible to screen the data close to clouds?

Page 11, Line 7-8: What is the rationale for selecting PBL height as 2 km? How do authors measure the PBL height (Page 12, Line 5)?

Page 13, Line 8-10: To assess the possibility of the hygroscopic growth of aerosols on the AOD versus q relationship, authors have to provide the ranges of relative humidity.

Page 25, line 29: replace “continental boundary layer over land” with “continental boundary layer” (or boundary layer over land).