RESPONSE TO REFEREE 1

First of all, the authors acknowledge the referee 1 and the editor for the time spent to review this manuscript and also for their constructive comments. Note that the reviewer's comments are highlighted in blue-light font and our answer can be read in normal font. The modifications are indicated by blue font, and the removed text is shown in red and crossed out in the revised manuscript.

Referee 1: This paper reports on smoke observations over southern Africa during September and October 2022 as part of the Biomass Burning Aerosol Campaign (BiBAC). The paper pulls together AERONET sun photometer data, CALIPSO/CALIOP lidar level 3 backscatter profiles, MODIS/IASI AOD and CO and CAMS aerosol analyses to describe a series of smoke events in and around Africa as well as a case of trans Atlantic transport from South America. After an overview of the intensive operations period each case is given a short observational summary meteorological analysis. I think overall it is publishable material and provides a needed overview of the meteorological conditions of BiBAC. This said, I am recommending major revisions largely on writing/communications issues.

Authors: We regret for the language usage which has arisen the referee concern. The purpose of the present study is to highlight the transport modes which explain the transport of biomass burning plumes over the Southwest Indian Ocean (SWIO) basin during the BiBAC campaign. In order to clarify the objective of the paper, this latter was re-organized in the revised manuscript. In particular, Section 4 which treats on the synoptic and meteorological conditions driving the transport of the biomass burning plume during the BiBAC campaign was significantly re-organized in the revised manuscript. Indeed, this section was rewritten by corrected the inappropriate meteorological diction as suggested by the referee 1. In the revised manuscript, the AERONET data at level 2 was used in order to improve the significance of our results. To better characterize the synoptic conditions occurred during BiBAC, cloud cover products from CAMS reanalysis was added in the dataset used in this study. In order to emphasis on the synoptic conditions and not to extend the overall text length, we removed the paragraph mention about the aerosol size distribution evolution over Maputo. Thereby,the revised manuscript solely focused on meteorological and synoptic conditions driving the transport of biomass burning plume over SWIO basin. The motivations come from the fact that few studies treating on the transport of the biomass burning plume in the SWIO basin (Flamant et al., 2022; Swap et al., 2003; Schmid et al., 2003). These previous works pointed out a main transport mode over the SWIO basin which shaping like a river of smoke. In the present study, the structure of smoke river is also found but under different synoptic conditions than those reported by these previous works. We focused our effort to describe properly (with the appropriate language) these news synoptic conditions leading

to river of smoke over the SWIO basin. These news synoptic conditions which occurred during the events detected during the BiBAC campaign are reported in the Figure 1 (This figure was included in the revised version, as Figure 13).

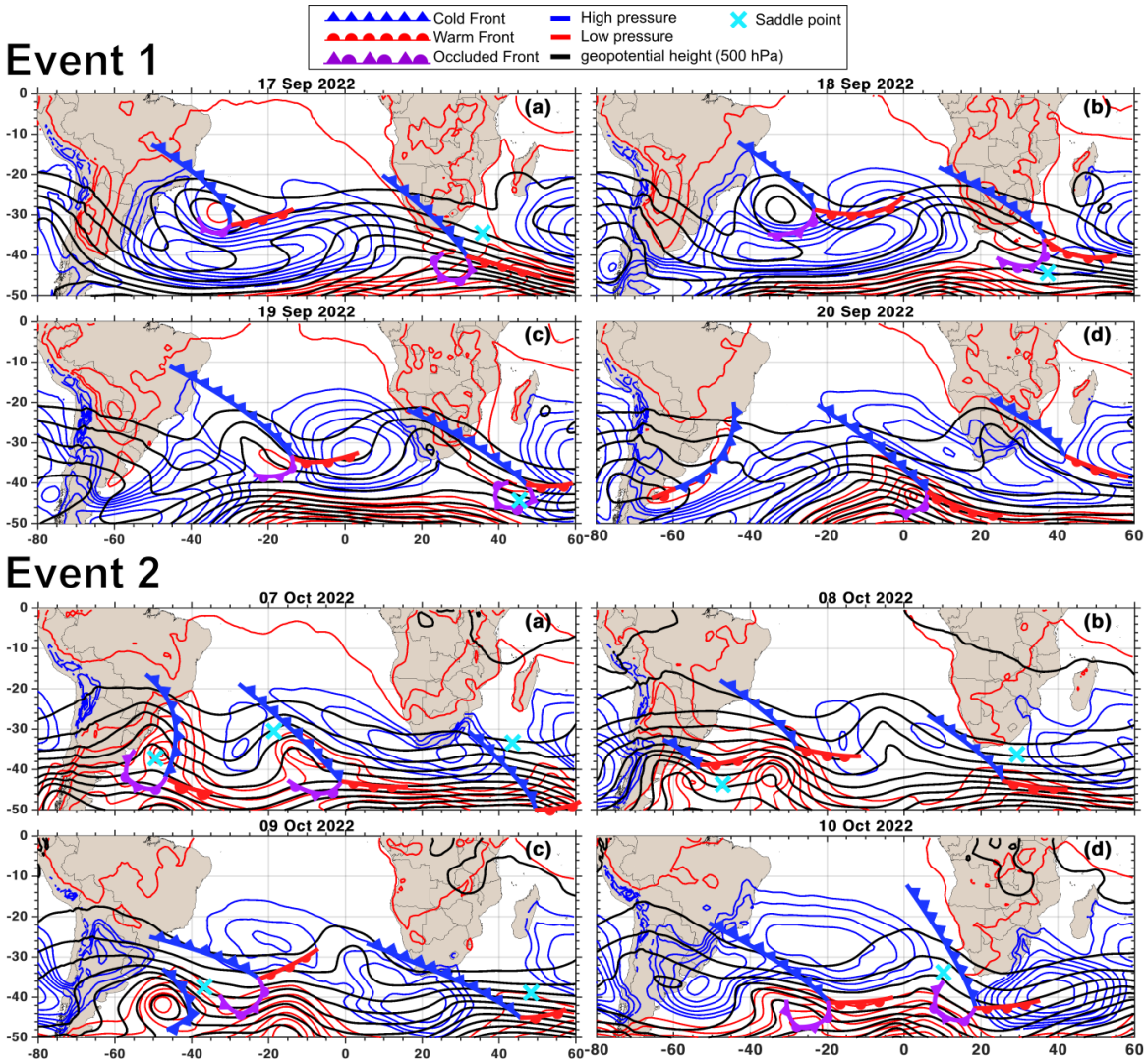

Figure 1: Meteorological features favoring the transport of aerosols and CO plume during Event 1 (top panel) and Event 2 (bottom panel). Frontal systems are : cold front in blue, warm front in red and occluded front in purple. Mean sea level pressure : low and high in red and blue lines, respectively. The geopotential at 500 hPa is represented by black lines and the location of saddle point by cyan cross.

In the previous works, the synoptic conditions responsible for the formation of the smoke river involved the propagation of a westerly wave and the development of a cut-off low (Swap et al., 2003; Stein et al., 2003; Flamant et al., 2022). However, we observed during the event 1 a river of smoke structure involved by westerly wave without a cut-off-low. The river of smoke developed in a synoptic context characterized by three successive cold fronts associated with saddle points during the event 2. Language usage has been appropriately corrected for the better readability of the article as suggested by the referee.

Referee 1: Language is a little bit off throughout, which might be a language/translation issue. I think the paper needs a very solid edit to ensure clarity to the reader and use of proper meteorological diction. For example, in the abstract "anti-cyclonic system, and warm air column resulted in stable conditions, which was also influenced by strong subsidence." The language is a bit odd, in that should the anticyclone have to be in an area of subsidence? Or was it an anticyclone that was imbedded in a larger region of subsidence or as part of a ridge?

Authors: We thank for the referee comment. As a mentioned previously, the synoptic conditions have been rewritten in the revised manuscript. Thus, this part of the manuscript has been rewritten by using appropriate meteorological diction. Furthermore, we included new figures in order to clarify the synoptic description associated with both events (e.g, Figure 1).

Referee 1: Also, perhaps it is cleaner to discuss "The study investigates the long-range transport of biomass burning from South America to Southern Africa, with the plume exiting over southern Brazil, likely driven by the Southern American low-level jet (SALLJ), which is driven by climate forcing like El Niño–Southern Oscillation (ENSO) and Madden-Julian Oscillation (MJO)." Is this part of the focus of the two events discussed earlier, separate? Further ENSO and the MJO are distinctly not climate phenomena, but rather seasonal and sub seasonal. These are just minor early examples, but throughout the read I was constantly trying to figure out what the authors are trying to convey.

Authors: During both events, the CO and aerosols variability over South Africa are explained by regional and intercontinental transport. The confusion comes from the fact that these two transport modes have been discussed in separate paragraphs in the previous version of the manuscript. In order to reduce the confusion, this discussion have been restructured in the revised manuscript. Indeed, the discussion on the transport mode of the biomass burning plume (at regional and intercontinental scales) has been structured around the two events (See Section 4). Beyond the restructuring, the discussion on the transport mode has been rewritten by using the appropriate diction. As a consequence, the confusion pointed out by the referee 1 with the use ENSO and MJO terms has been clarified.

Referee 1: Another example, Introduction, line 55 "The vertical distribution of aerosols determines their radiative impact, as well as their atmospheric residence time, which will affect any aging processes and the resultant horizontal distribution following advection" One cannot really say generalities in such blanket statements, as depends on what radiative impact you are talking about, and the nature of the transport pattern. For shortwave

fluxes, it makes almost no difference at all. If you talk about heating rates, then certainly. But also don't intensive properties such as particle phase function and absorption coupled with concentration define the radiative effects?
Authors: We agree with the referee. The corresponding sentence has removed in the revised manuscript.

Referee 1: Other major issues include undefined acronyms and figure lettering that is to small to read. All of these issues get in the way of the reader extracting meaningful information. To be sure this is a useful effort, but please have another go and pay attention to proper technical term usage and I will be happy to give it another read.
Authors: We thank the referee 1 for this comment. All acronyms have been defined in the revised manuscript. Furthermore, the quality of figure and its lettering have been checked in the revised manuscript.

References

Flamant, C., Gaetani, M., Chaboureau, J.-P., Chazette, P., Cuesta, J., Piketh, S. J., and Formenti, P. (2022). Smoke in the river: an Aerosols, Radiation and Clouds in southern Africa (AEROCLO-sA) case study. *Atmospheric Chemistry and Physics*, 22(8):5701–5724. Publisher: Copernicus GmbH.

Schmid, B., Redemann, J., Russell, P. B., Hobbs, P. V., Hlavka, D. L., McGill, M. J., Holben, B. N., Welton, E. J., Campbell, J. R., Torres, O., Kahn, R. A., Diner, D. J., Helmlinger, M. C., Chu, D. A., Robles-Gonzalez, C., and de Leeuw, G. (2003). Coordinated airborne, spaceborne, and ground-based measurements of massive thick aerosol layers during the dry season in southern Africa. *Journal of Geophysical Research: Atmospheres*, 108(D13). _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1029/2002JD002297.

Stein, D. C., Swap, R. J., Greco, S., Piketh, S. J., Macko, S. A., Doddridge, B. G., Elias, T., and Bruintjes, R. T. (2003). Haze layer characterization and associated meteorological controls along the eastern coastal region of southern Africa. *Journal of Geophysical Research: Atmospheres*, 108(D13). _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1029/2002JD003237.

Swap, R. J., Annegarn, H. J., Suttles, J. T., King, M. D., Platnick, S., Privette, J. L., and Scholes, R. J. (2003). Africa burning: A thematic analysis of the Southern African Regional Science Initiative (SAFARI 2000). *Journal of Geophysical Research: Atmospheres*, 108(D13). _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1029/2003JD003747.