RC2: 'Comment on egusphere-2023-681', Anonymous Referee #2, 04 Oct 2023 : **reply by the authors in blue characters**.

In this manuscript entitled 'Impact of the Guinea Coast upwelling on atmospheric dynamics, precipitation and pollutant transport over Southern West Africa' de Coëtlogon et al. analyse the mechanism by which a zonal band of precipitation over West Africa is pushed North over the Sahel starting in late June/early July. Their work and the simulations presented are based upon the proposition of Tanguy et al. (2022), based on satellite observations, that the main driver for pushing North the precipitation are the sea-surface temperatures of the coastal upwelling near the coast of Guinea.

In contrast to Tanguy et al. (2022) this work is based on the analysis of two ensemble of simulations, one with warmer SSTs near the Guinean coast and a second one with warmer SSTs than the ensemble that was run as the control. The SST anomaly created amounts to 0.5°C on June 15th and 1.0°C on July 7th, the variability is conserved by the method. The diagnostics presented in the manuscript show how the meridional circulation changes in response to these warmer and colder temperatures, entraining (respectively slowing down) the transport of water vapor and hence the precipitation inland (northward from the Gulf of Guinea). These SST anomalies dampens the precipitation in the case of the cold upwelling by decreasing the convergence of humidity whereas the reverse is true when SSTs are increased (warm upwelling). The analysis through the diagnostics presented in the paper is convincing and the two ensemble of simulations illustrate well the role played by the convergence of humidity in this coastal region.

First, we want to express our sincere gratitude to the anonymous reviewer for their careful review of our study. Below, you will find our responses to the questions in blue characters to facilitate distinction.

I have two remarks that might improve the manuscript.

The introduction focuses solely on how the Sahel precipitation is affected by the mechanism at hand that is the variations of SST near the coast of West Africa and in particular near Guinea and Benin. It would be useful to remind the reader that other processes play a role in the position and the strength of the precipitation over the Sahel as described by the following authors: Haywood et al., 2016; Miller et al., 2014 and Balkanski et al. 2021.

Thanks for this suggestion, the following lines were therefore added in the first paragraph of the introduction : « The location and intensity of Sahel precipitation in boreal summer are mainly controlled by the zonal tropical overturning circulation and the mid-tropospheric African Easterly Jet (AEJ) and high-tropospheric Tropical Easterly Jet (TEJ), which are maintained by two diabatically forced meridional circulations, one associated with deep moist convection and a second from dry convection to the north over the Sahara (Haywood et al. 2016). In addition, aerosols play an important role, as the absorption of sunlight by dust affects not only surface temperature but also surface wind speed, vegetation and humidity transport, leading to complex

interactions (Miller 2014). Balkanski et al. (2016) also highlighted the potential for a stabilizing feedback loop involving dust emission, atmospheric absorption, and Sahel precipitation in climate models. »

The second remark concerns the analysis of the effect on pollution which is analysed for the five main cities affected by the changes in circulation brought about by the upwelling temperature (Abidjan, Ivory Coast; Accra, Ghana; Lom, Togo; Cotonou, Benin and Lagos, Nigeria). Using a generic tracer for pollution gives an information about the relative variations that pollutants will incur but it would be much more informative to have run a model with a full or a simplified chemistry to study how this translates into concentrations for the main pollutants that are: O3, NOx, SOx.

This study is above all based on the study of dynamical processes, and in this case, the use of passive tracers has an advantage: the simulated concentrations accurately reflect the variations in meteorology and only in this process. Active chemistry cannot change the values and thus alter the interpretation linked to the meteorological process studied. The reviewer is right to say that chemical modeling would provide other answers. But the article already seems long enough to us and this would, in our opinion, introduce a 2nd subject in this article. We are keeping this interesting idea in mind and we will probably be able to make another study of it: we will then have to completely revise the chemical boundary conditions (very important in this region with sea-salt, fire and dust emissions and transport), the high-resolution anthropogenic emissions inventory over the region and implement everything in a coupled configuration of the WRF and CHIMERE models. It's a consequent work, and a long way from the present study. We nonetheless changed the title of this section form « Pollutant transport » into « Tracers transport », which seems to us more representative of its content.

All references in the manuscript need to be checked as some are incomplete.

For example:

Tanguy, M., De Coëtlogon, G., and Eymard, L.: Sea surface temperature impact on diurnal cycle and seasonal evolution of the Guinea coastrainfall in Boreal spring and summer, Monthly Weather Review, ?, ?, https://doi.org/?, 2022.

Done.

Taking into consideration the two remarks this manuscript is worthy to be published in Atmospheric Chemistry and Physics.

Again, thanks a lot for the careful reading !

references cited:

Tanguy, M., De Coëtlogon, G., and Eymard, L.: Sea surface temperature impact on diurnal cycle and seasonal evolution of the Guinea coastrainfall in Boreal spring and summer, Monthly Weather Review, 150, 12, pp. 3175-3194, https://doi.org/10.1175/MWR-D-21-0155.1, 2022.

Haywood, J. M., Jones, A., Dunstone, N., Milton, S., Vellinga, M., Bodas-Salcedo, A., Hawcroft, M., Kravitz, B., Cole, J., Watanabe, S., and Stephens, G.: The impact of equilibrating hemispheric albedos on tropical performance in the HadGEM2-ES coupled climate model, Geophys. Res. Lett., 43, 395–403, https://doi.org/10.1002/2015GL066903, 2016.

Miller, R. L., Knippertz, P., Pérez García-Pando, C., Perlwitz, J. P., and Tegen, I.: Impact of Dust Radiative Forcing upon Climate, in: Mineral Dust: A Key Player in the Earth System, edited by: Knippertz, and Stuut, J.-B. W., Springer Netherlands, Dordrecht, 327–357, https://doi.org/10.1007/978-94-017-8978-3_13, 2014.

Balkanski, Y., Bonnet, R., Boucher, O., Checa-Garcia, R., and Servonnat, J.: Better representation of dust can improve climate models with too weak an African monsoon, Atmos. Chem. Phys., 21, 11423–11435, https://doi.org/10.5194/acp-21-11423-2021, 2021.