

Atmos. Chem. Phys. Discuss., referee comment RC1 https://doi.org/10.5194/acp-2021-407-RC1, 2021 © Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.

Comment on acp-2021-407

Anonymous Referee #1

Referee comment on "Anthropogenic aerosol effects on tropospheric circulation and sea surface temperature (1980–2020): separating the role of zonally asymmetric forcings" by Chenrui Diao et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-407-RC1, 2021

Review of:

Anthropogenic Aerosol effects on Tropospheric Circulation and Sea Surface Temperature (1980-2020): Separating the role of Zonally Asymmetric Forcings

By Diao et al.

This paper utilizes the CESM large ensemble simulations and its single forcing simulations component to study aerosol effect on surface temperatures and atmospheric circulation. In addition, two new sets of ensembles of simulations with the CESM are presented. These simulations are designed to capture the shift in recent decades in aerosol forcing from the western hemisphere mid-high latitudes (USA and Europe) to the eastern hemisphere low-mid latitudes (mostly India and Chania). The new simulations are well executed set of numerical experiments, which presents a valuable contribution to the climate community. I agree with the authors' statement that: "The zonally heterogeneous changes in AA emissions since the late 20th century, ..., received less attention". However, I fill that this paper fails to present the current knowledge in the field. In addition, the paper is mostly descriptive and the physical explanations are lacking (please see more details below). Finally, the paper could benefit from a carful re-writing and editing as some parts are not writen well and I found numerous typos. Having said that, I believe that after a major revision, this paper could make important contributions to understand aerosols' climatic impacts.

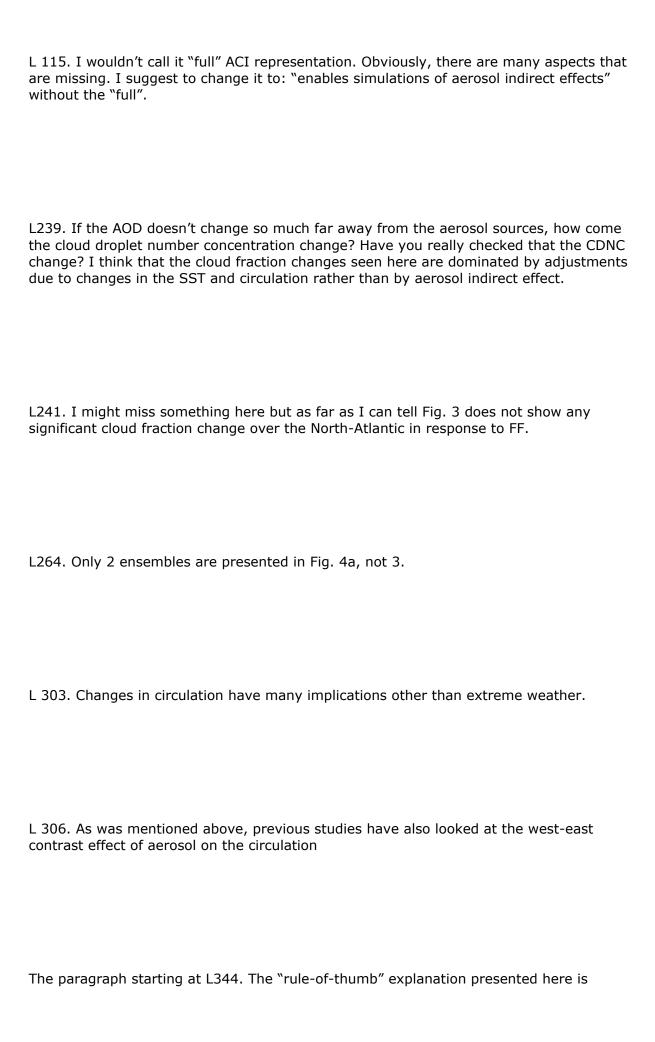
General comments

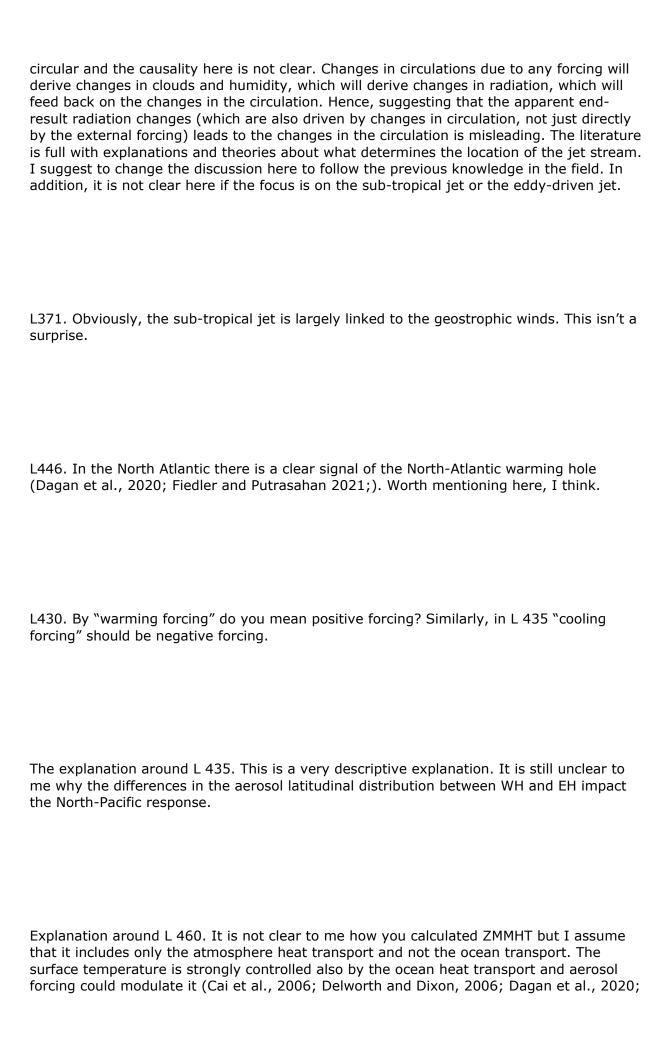
- As was mentioned above currently the paper is mostly descriptive and so little physical insight is gained. Specifically, the explanation of the circulation response is lacking. I have outline below a few examples but there are defiantly more. Hence, I would like to encourage the authors to conduct deeper thinking and to try to bring the dynamical discussion to a level suitable for publication.
- The introduction is lacking many previous studies that examined the aerosol geographical distribution effect on circulation, forcing and temperature. Although I agree that this issue should get more attention, from the current manuscript it could sound almost like it is the first time anyone looked at it. This is not the case. A few examples of papers which come into my mind are Fiedler et al., 2017; Chemke and Dagan 2018; Persad and Caldeira 2018 and Fiedler and Putrasahan 2021. In addition, the introduction focusses quite a bit on extremes. As this is not the focus of this paper, it is unclear to me why.

Specific comments

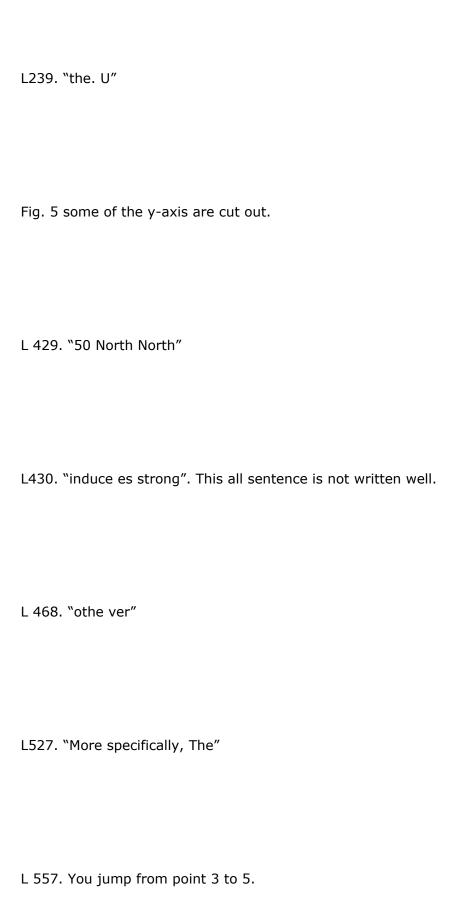
L 13-14: this sentence sounds a bit awkward. Consider re-writing.

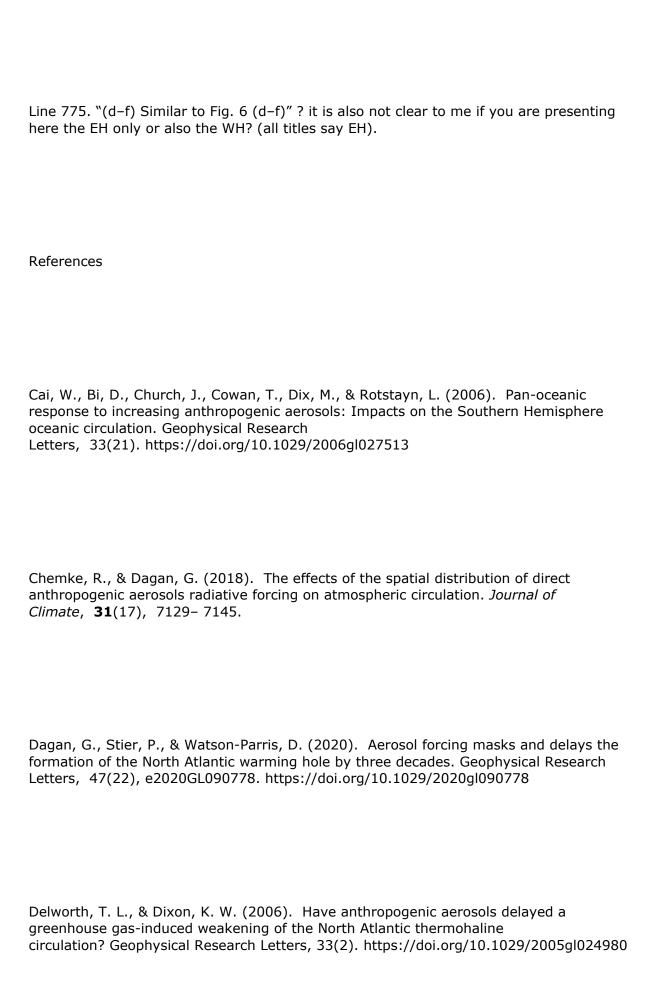
L 92. It defiantly also played a role in the north Atlantic. The motivation of focusing only on the north Pacific is not clear.

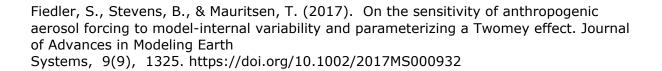




Menary et al., 2020; Fiedler and Putrasahan 2021; Hassan et al., 2021). This is something that can't be ignored, definitely for the North-Atlantic. This comment about the role of the ocean circulation changes in shaping the SST (or SAT) is true also for many other parts of this paper. It can't be simply ignored.
L 481-489. This is not a main finding of this paper. The trend of a shift in aerosol forcing from the WH to the EH in recent decades is well known and was discussed in many previous studies.
Technical comments
L69: "et al., 2014". Please correct.
L 90. "Northern Hemisphere, We". Please correct.
L 95. "radiation(Sect. 3.1)"
L 217. "(1)1"







Fiedler, S., & Putrasahan D. (2021). How Does the North Atlantic SST Pattern Respond to Anthropogenic Aerosols in the 1970s and 2000s? Geophysical Research Letters, https://doi.org/10.1029/2020GL092142

Hassan, T., Allen, R. J., Liu, W., and Randles, C. A. (2021). Anthropogenic aerosol forcing of the Atlantic meridional overturning circulation and the associated mechanisms in CMIP6 models, Atmos. Chem. Phys., 21, 5821–5846, https://doi.org/10.5194/acp-21-5821-2021

Menary, M. B., Robson, J., Allan, R. P., Booth, B. B., Cassou, C., Gastineau, G., et al. (2020). Aerosol-forced AMOC changes in CMIP6 historical simulations. Geophysical Research Letters, 47, e2020GL088166.

Persad, G.G., & Caldeira, K. (2018). Divergent global-scale temperature effects from identical aerosols emitted in different regions. Nat Commun 9, 3289 https://doi.org/10.1038/s41467-018-05838-6