

# ***Interactive comment on “Relationship between Asian monsoon strength and transport of surface aerosols to the Asian Tropopause Aerosol Layer (ATAL): Interannual variability and decadal changes” by Cheng Yuan et al.***

**Anonymous Referee #3**

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This study utilizes the MERRA2 reanalysis data to explore the influence of the Asian monsoon system on the Asian aerosol layer near UTLS. The topic is important, as aerosols in such high altitude likely get involved in the long-range transports and exert radiative impacts over the other regions around the world. It is also the first time to exploit MERRA2 in such a topic, even though the uncertainty of MERRA2 aerosol product remains to be gauged. The main finding about stronger Asian monsoon resulting in more abundant aerosols near UTLS reveals the relative importance of two competing mechanisms, i.e. the enlarged convective transport and enhanced precipi-

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tation washout in those stronger monsoon year. Therefore, I recommend accepting the manuscript by ACP pending minor revisions.

- 1) One caveat of using MERRA2 aerosol product is its simplistic treatment of aerosol mixing state in its aerosol model GOCART, as GOCART assumes all aerosol types are externally mixed. Recent modeling studies [e.g. Wang et al., 2018, JAMES] have suggested that the mixing state and aerosol aging processes in GCM or CTM can largely change the aerosol lifetime, and consequently affect the amount of aerosols lifted to UTLS. Recent aerosol optical measurements further supported that even mineral dust can be coated by a significant amount of anthropogenic aerosols over East Asia [Tian et al., 2018, ACP]. Therefore, such a caveat in data and possible implications should be discussed in the paper.
- 2) Fig. 2a, the differences between red and blue contour lines are not clear. Can you find a better way to present them? Simply plot the differences of Z100? Fig. 2b is too small to see the details. Please consider to enlarge it.
- 3) For the interannual variability. I think the monsoon strength is definitely linked with some other climate natural variability, such as ENSO. It would be interesting to see some correlation analyses between the AMA strength, aerosol loading, and some natural variability indices, and trend analyses after those natural variabilities get removed.
- 4) L114-115, it should be pointed out that this sentence cannot be applied to Fig. 1 as the anomaly definition there is different with the other plots.
- 5) Some typos: L105, annual mean L159, over the western sector

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