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Comment on acp-2021-40: Finding on relation ET-VPD-AOD is very interesting, but demands more analysis

Anonymous Referee #2

Referee comment on "Observations of aerosol–vapor pressure deficit–evaporative fraction coupling over India" by Chandan Sarangi et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-40-RC2>, 2021

Review of Observations of Aerosol-Vapor Pressure Deficit-Evaporative Fraction coupling over India

This paper is an interesting discussion of the link between aerosols, vapor pressure deficit and evapotranspiration over India. The paper presents some interesting findings: 1) sensible heat is lower under heat wave conditions, 2) latent heat is enhanced under aerosol loading due to diffuse fertilization, and 3) decoupling of the vapor pressure deficit response under high aerosol load.

These are very interesting findings, as they turn out to be different than what is common knowledge for regions that do not have the aerosol load of India and provides insights into the coupled behavior of air pollution, vegetation, and weather.

Major comments:

* The finding that the evaporation response to vapor pressure deficit becomes really weak under a high aerosol optical depth is very interesting, but also controversial. The authors demonstrate the opposite findings in a modelling study, which shows that their results might be very important. At the same time: one figure (Fig. 4) does not really convince me. The explanation of it remains rather limited and I think that this finding deserves a far more thorough analysis before this paper can be accepted. Vapor pressure deficit is not the only driver of stomatal resistance, and it would be good to carefully look into each of them. It would be nice to analyze here a few diurnal cycles into detail. I would like to see the evolution of the evapotranspiration and specific humidity, next to the radiation and the surface temperature.

* The inversion of Penman-Monteith that leads to figure 4 is not reproducible. I would like to see this method thoroughly described in the paper. Furthermore, I am a little skeptical of

using surface temperature here. Please also compute the stomatal resistance using the air temperature as Penman-Monteith does as well.

Minor comments:

* In my view, all acronyms could be replaced by written words in order to make the paper more readable. It does do no harm if the paper is 20 lines longer for that reason.

* The overall quality of the figures is too poor for publication. Please make sure all figures have a consistent font size, are not stretched and have either a vector format, or a high enough resolution.

* Please use units consistently, I see W/m² as well as W m⁻². Please add a space between different units.

* Line 71-73: the paper of Van Heerwaarden & Teuling (2014, Biogeosciences) shows exactly the threshold where VPD increase leads to a shutdown, rather than increase in ET.

* Figure 4: Please check the units of VPD, these must be Pa for these values.