

### Response to the comment from Anonymous Referee #3:

The authors have made most corrections, and there is one comment not adequately addressed.

Comment 5: Page 9 line 5, “the increase of PM<sub>2.5</sub>, N<sub>p</sub> and T<sub>a</sub> decreased cloud droplet sizes (Rosenfeld et al., 2014a), decreased the ambient supersaturation, enhanced the evaporation of small droplets (Ackerman et al., 2004), and finally caused the cloud events to vanish (Mazoyer et al., 2019).” Here the authors claimed that aerosols enhanced evaporation and caused cloud events to vanish by referring to early studies. This statement, however, is in contrast to the authors’ statement in the abstract “we find that the albedo can increase 36.4% if the cloud gets to be disturbed by aerosols. This may induce a cooling effect on the local climate system”. Has this lifetime effect been considered in your calculation?

Enhanced evaporation will reduce the lifetime and cloud, resulting in a warming effect. Since you made this statement and talked about aerosol climate effects, I was asking if you have taken this into account. If not, you should make caveats and show a whole picture to avoid misleading messages.

**Response:** We sincerely thank the reviewer for the positive comment on our revised manuscript. We did not take the lifetime of cloud into account during the calculation. We added the caveats to specify the conditions, under which our results were derived, in the discussion part in Page 13 Line 17-18.

“Note that the increase of  $N_c$  could enhance the evaporation and further reduce the lifetime of cloud, which was not taken into account when calculating the induced albedo.”

## Responses to the editor's comments:

### Comments to the Author:

The authors have addressed most of the reviewer comments. There are still a number of points that need to be corrected for before publication in ACP. Please address the important point raised by Reviewer #1 (see the attached report) and the following issues that I discovered in an editorial review of the manuscript:

We sincerely thank the editor for the valuable comments and suggestions. We have responded the editor's comments one by one in the following. Comments by the editor are given in black normal font, and our response to the comments is shown in blue. Newly added and modified text in the revised manuscript is given in red.

### Comment 1

- The manuscript still needs to be proofread and corrected for grammatical errors. Please make sure this is done before the final submission.

**Response:** Thank you for the comment. We have proofread our manuscript and corrected the grammatical errors.

### Comment 2

- Page 6, line 8: Please add "here" between "which" and "represent"

**Response:** We have revised this sentence as you suggested. (Page 6 Line 6-7)

“Aerosol indirect effect (AIE), which **here** represents simply approximations of the derivatives of the cloud microphysics ( $r_{eff}$  and  $N_C$ ) with respect to changes in aerosol concentrations”

### Comment 3

- Please make sure you cite all figures in the order in which they are presented. Revise the order of figures, if need be.

**Response:** We have rearranged and rechecked the order of the tables and figures. They are now cited in the order.

### Comment 4

- P. 7, lines 10-21: Please do not refer to the cloud events before they are introduced.

**Response:** We rechecked about this through the whole manuscript. We make sure that cloud events were first introduced (expressed as CE-xx) and then be referred to.

### Comment 5

- P. 7, lines 27-28: Please state more explicitly (with the relevant numerical values) why this was the case and how the calculations were made with appropriate references to the supplement.

**Response:** We explained the calculation with the numerical values and revised more detailed in Page 7 Line 24-28.

“The detailed information could be found in the Supplement (Table S2, Fig. S3 and Fig. S4) and was briefly introduced here. The sampling angle ( $\theta_s$ ) and  $v_{ip}$  for CP-1 and CP-2 were  $11.9^\circ$  and  $0.82 \pm 0.29$

$\text{m s}^{-1}$ , and  $10.6^\circ$  and  $0.92 \pm 0.36 \text{ m s}^{-1}$ , respectively (Table S2). According to the calculations provided by (Spiegel et al., 2012), the aspiration efficiency and transmission efficiency were all close to 1.”

#### **Comment 6**

- P. 8, lines 26-28: Since causality cannot be proven based on just the data, please replace "would cause" with "is observed to coincide".

**Response:** Thank you for the comment. This sentence was revised as “In S4, the increase of  $\text{PM}_{2.5}$ , through evaporation of cloud droplets or lifting of  $CBH$  (Fig. 2), was observed to coincide with the vanishment of cloud events (Mazoyer et al., 2019; Li et al., 2017a).” (Page 8 Line 24-26)

#### **Comment 7**

- Section 3.2.1: Please carefully go through and revise this section to accurately describe and distinguish covariation and causality. Most of the data presented show covariations (or not) between different variables, but causality is difficult to prove.

**Response:** We have revised the Section 3.2.1. Consistent variation and inverse variation between  $N_P$  and  $N_C$  were clearly pointed and described. We weakened some statements and expressed the possible reasons according to our results.

#### **Comment 8**

- P. 11, line 3: Isn't this paragraph somewhat contradictory to what has been said before? Please revise.

**Response:** We made a mistake in the equation of  $AIE_N$  in section 2.7 in the last version, that the negative sign should be removed. This mistake may cause the contradictory. We have corrected the equation in the revised manuscript. The description is not contradict, but we have changed the order of the description in section 3.2.2 to make this part more clear. The positive values of  $AIE_r$  and  $AIE_N$  represent that  $N_C$  increases with the decrease of  $r_{eff}$  and the increase of  $N_P$ , and vice versa. During CP-1 and CP-2, no negative values of  $AIE_r$  and  $AIE_N$  were observed, while the specific values of  $AIE_r$  and  $AIE_N$  during CP-1 and CP-2 were different.

#### **Comment 9**

- P. 14, Section 4: Please revise also this section to accurately describe covariation vs. causality in the data set.

**Response:** We have revised the conclusion part and clearly pointed and described about the covariation and the causality. We weakened some statements and expressed the possible reasons according to our results.