Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Exploring the First Aerosol Indirect Effect over the Maritime Continent Using a Ten-Year Collocated MODIS, CALIOP, and Model Dataset" *by* Alexa D. Ross et al.

Anonymous Referee #3

Received and published: 16 April 2018

Ross et al. (2018) uses ten years of satellite-based observations and NAAPS reanalysis data to examine the first aerosol direct effect in Southeast Asia (SEA). The combined satellite-based dataset (termed "CCARA" or "Curtain Cloud-Aerosol Regional A-Train") is an invaluable resource for aerosol-cloud research over Southeast Asia (SEA), given the care taken to screen cloud contamination in the cloud-endemic region and assemble the observations into a coherent package. I am looking forward to see more future work based on CCARA. However, the following general and specific comments should be addressed for this manuscript. Suggested changes are also included in uploaded pdf.

General comments:

1) Comprehensive literature review on related studies in SEA (besides classics on aerosol effects and authors' publications) is needed to put the work in context. E.g., Lin et al. (2014) gave an overview on interactions between biomass burning aerosols and clouds over SEA, and Lee et al. (2014) modelled the impact of aerosols on atmospheric circulation and rainfall over SEA.

2) I think the structure of the paper is slightly skewed at the moment. The paper devotes almost half of the pages to introduction and methods, and the other half to results. Given that the paper describes a new dataset, a comprehensive coverage to the methods is quite understandable. That being said, the discussions on the results are thus comparatively limited. I think more discussions of these results in relation to the biomass burning and pollution situation in SEA are possible. Pls see specific comments for more details.

3) I think the authors can make better use of the figures to expand the discussions. E.g., panels in the figures can be labelled "a, b, c...". Firstly, this will help the readers to relate the in-text discussions to the different panels in the figures or features within the panels. Secondly, the authors may also find it easier to focus on specific panels to highlight point of interests. Pls see specific comments for more details.

E.g., the punchline of the paper in my opinion is Figure 8 and 9 and are discussed in only two pages out of 17 pages of text, focusing mainly on the statistics on what made the FAIE signal significant. There are maybe two paragraphs (less than a page) on how these results relate to biomass burning and pollution over the region. Moreover, these two figures are rather complicated for the uninitiated, and consists spatial, temporal and vertical info for 6 land regions and 20 sea regions (4 aggregated sea regions). The authors should expand the discussions to take the readers through the richness of these two figures.

Are there opportunities to explore how the variations of injection heights of smoke and

pollution impact the cloud reff at each level? E.g. look carefully at Sumatra and Java for Figure 9. reff for Sumatra gets warmer (decreases) downwards vertically, but reff for Java seems be warmest (lowest reff) at 3 - 4.5 km. Perhaps the authors can explore if this be due to convective pumping bringing the pollution (not smoke) to that level? Do note that these are suggestions to take the discussion further in more details.

4) The authors should refer to ACP manuscript preparation guidelines for authors (at https://www.atmospheric-chemistry-and-physics.net/for_authors/manuscript_preparation.html) when preparing manuscript.

E.g. Pg 6 Ln 25: "as illustrated in Figure 1" should be "as illustrated in Fig. 1" according to guidelines.

Another e.g. within the same line: "333-m" should be "333 m" according to house standard not to hyphenate modifiers containing abbreviated units.

The authors should also check the language within the manuscript (some suggestions are given in the uploaded pdf). There are also numerous use of semicolons which break up the flow in the text (pls see uploaded pdf as well).

Specific comments:

Title: The entire SEA is effectively covered in the study. It will be appropriate to title the manuscript as such.

Abstract: You may want to introduce CCARA here to the scientific community. This is important as interested readers will pick it up immediately and possibly relate to future work using the dataset. You don't want CCARA to be lost in the rest of the text.

Pg 2 Ln 17: I have not seen this term "Greater Southeast Asia" being used in literature. Pls remove it.

Pg 6 Ln 1 - 3: I understand that ECMWF met data performs well for SEA, but it is equally important that NAVGEM performs well too as it is used to drive aerosol transport used

in the study. The authors should provide evidence that the mismatch between met and modelled aerosol parameters is acceptable (e.g., statistics from the data) or only the mentioned key parameters of e.g., wind shear, water vapor, are important for the phenomenon being studied (e.g., citations).

Section 3.1.1: Injection heights of biomass burning smoke is extremely important for determining the vertical distribution of biomass burning aerosols. How is the injection height in NAAPS determined? Does the method matter for the different varieties of "biomass burning" present in SEA (Reid et al., 2013)?

For SEA, biomass burning emissions does not seemed to be directly injected into the middle to upper troposphere (Campbell et al., 2013; Tosca et al., 2011). As mentioned by Reid et al. (2013), the type of "biomass burning" in SEA actually varies a lot, thus possibly resulting in a wide range of injection heights. The authors should discuss the bias for CALIOP-NAAPS in more details framed in the context of the above-mentioned papers. The model results seems to be higher than the CALIPSO results, especially for ocean (Fig. 5).

Pg 8 Ln 9 - 16: The four larger ocean grids (e.g., ocean - south west) mentioned here should be named. They are later mentioned in Table 1 without reference back to Figure 3. A single sentence in Section 3.1.2 like e.g., "the north west, north east, south west and south east of ocean mentioned in Table 1 are with reference to the larger ocean grids (Fig. 3a)." will help the readers much in understanding the analysis.

Pg 11 Ln 4 and 9: Campbell et al. (2012) are cited in text while referenced as Campbell et al. (2013) in reference seciton. Pls kindly check through text for citation errors.

Section 3.1.3: Where is West Pacific (Pg 13 Ln 9)? This is an example of figures that could be used more effectively. I suppose the region to look at is the 3 grids at the top right hand corner of each panels (similar to West Pacific as mentioned in Figure 7 bottom panel). If the boundaries of the 3 grids can be made bold, it will make it easier for the readers to follow. Pls identify similar issues with the use of figures within the

manuscript and make changes. I have highlighted a few (pls see uploaded pdf).

Section 3.2.2: It is difficult for the readers to follow the impact of smoke on reff without visualizing the spatial distributions of smoke transport (or plumes) over SEA. It may be good to include NAAPS AOD plots for boreal summer and winter in the manuscript as well to orientate the readers to the direction of smoke transport.

Figure 6: Pls consider swapping info for "E. Indon." with "Philip." When the reader go through the info, they would expect it to be presented in a logical manner. If you swap info for "E. Indon." with "Philip.", you will be going through the land regions in a counter clockwise way, with Indochina at the top, moving south to Sumatra, moving east to Java, followed by Borneo and E. Indonesia and finally, moving north to Philippines. Currently, it seems you are moving counter clockwise, then suddenly zipping to Philippines on top, before going back to E. Indonesia.

Figure 7: These panels are of great interest to the region. Although it is not possible to present everything within the manuscript, but the summer and winter plots for every land and sea region should be included in a supplement.

Figure 8 and 9: The authors mentioned that the FAIE signal maps are shaded if the FAIE signal is deemed statistically significant. The problem is when you allocate white (or a pale color) to 0 FAIE signal in the color bar, it is difficult to differentiate whether an area is shaded or not.

Reference:

Campbell, J.R., Reid, J.S., Westphal, D.L., Zhang, J., Tackett, J.L., Chew, B.N., Welton, E.J., Shimizu, A., Sugimoto, N., Aoki, K., Winker, D.M., 2013. Characterizing the vertical profile of aerosol particle extinction and linear depolarization over Southeast Asia and the Maritime Continent: The 2007-2009 view from CALIOP. Atmos. Res. 122, 520–543. doi:10.1016/j.atmosres.2012.05.007

Lin, N.-H., Sayer, A.M., Wang, S.-H., Loftus, A.M., Hsiao, T.-C., Sheu, G.-R., Hsu, N.C.,

Tsay, S.-C., Chantara, S., 2014. Interactions between biomass-burning aerosols and clouds over Southeast Asia: Current status, challenges, and perspectives. Environ. Pollut. 195, 292–307. doi:https://doi.org/10.1016/j.envpol.2014.06.036

Lee, D., Sud, Y.C., Oreopoulos, L., Kim, K.M., Lau, W.K., Kang, I.S., 2014. Modeling the influences of aerosols on pre-monsoon circulation and rainfall over Southeast Asia. Atmos. Chem. Phys. 14, 6853–6866. doi:10.5194/acp-14-6853-2014

Tosca, M.G., Randerson, J.T., Zender, C.S., Nelson, D.L., Diner, D.J., Logan, J.A., 2011. Dynamics of fire plumes and smoke clouds associated with peat and deforestation fires in Indonesia. J. Geophys. Res. Atmos. 116, D08207. doi:10.1029/2010JD015148

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2018-4/acp-2018-4-RC2-supplement.pdf