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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Variations in optical properties of aerosols on monsoon seasonal change and estimation of aerosol optical depth using ground-based meteorological and air quality data" *by* F. Tan et al.

Anonymous Referee #1

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Review of the manuscript by Tan et al. submitted to ACPD

Tan et al. have studied the optical properties of aerosols in Malaysia and developed a regression model to estimate AOD in cloudy cases. The prediction of AOD is a very interesting topic but, unfortunately, the manuscript is really hard to read. The grammar and the structure of the manuscript need a lot of work before this work can be published. In addition, several figures are hard to read, especially from a printed version of the manuscript.

I don't understand why aerosol typing is discussed in this paper. Apparently, it has nothing to do with the AOD model. Furthermore, I'm skeptical on aerosol typing based only on AOD and Angstrom exponent. AOD provides information only on the amount of aerosols and Angstrom exponent gives some idea on the size. For a more reasonable typing you would need information on the absorption capability of the aerosols (which AERONET provides). See for example Lee et al. (2010) for more information. In my opinion, aerosol typing makes sense only if the results are used somewhere.

The description of the AOD model is confusing. I couldn't understand which data set was used where and why. For example, the subsetting of the data makes sense but I'm not sure if I was able to follow how it was done and how the different subsets were used. I assume that the first subset was used in the calculation of the coefficients for the equation 2 but these values for the coefficients were not presented anywhere. The section 3.5 is really confusing but I assume that here the predicted AOD values were compared with the corresponding AERONET AODs. I don't understand why this was done because in the next section (3.6) is the validation of the predictions using the second subset of data which makes sense.

Finally, the usage of lidar data in the evaluation of the model performance is a good idea but a single measurement is just not enough. Moreover, for a proper comparison with the lidar, you should use extinction profiles from which you could integrate AOD. Of course, there are no extinction measurements during the day but you could select a suitable lidar ratio and use that to calculate the extinction profile from the backscatter profile. Furthermore, the comparison with other linear regression models is also superficial.

Therefore, I suggest that the editor rejects this manuscript.

Here are my specific comments:

The manuscript has several grammar issues. For example: p 19749, l 6: "are hardly quantifiable" p 19749, l 10: "conveniently analyzes air quality/pollution" p 19753, l 5:

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"sourced from alternatively selected data" p 19754, l 7: "were hardly quantifiable" p 19755, l 5: "the lowest AOD ranged from" p 19759, l 25-28: the whole sentence p 19761, l 16: "in clearing atmospheric conditions"

p 19750, l 5: Why is continuous retrieval of AOD difficult? Satellite instruments and sun photometers do it continuously.

p 19750, l 21: Explain here what is API and how it is calculated.

p 19751, l 23: What do you mean with the optical properties? Precipitable water is not an optical property, it isn't even an aerosol property. It describes the amount of water in the atmospheric column.

p 19751, l 26: What is the value in seasonally discriminated aerosol types?

p 19752, l 8/13: Be more specific in the description of the data sets. What parameters (AOD, Angstrom?) from AERONET data were used? What parameters (visibility, API?) from NOAA data were used?

Section 3: In the text you talk about monsoon periods but in the plots you have monthly ranges. Therefore, it is hard to link the plots with the text. Use the same nomenclature through out the paper.

p 19755, l 11-14: How is precipitable water linked to aerosol size? What does the limit 4.1 mean here?

p 19756, l 2/5: What are Fig 1a(i) and (ii)?

p 19756, l 9: Based on Fig 1. I couldn't say that Angstrom exponent has noticeable trends.

p 19756, l 11: In other parts of the text you mention that the site is affected by marine aerosols. Usually, marine aerosols are thought to have coarse particles.

p 19756, l 25: How can you say that you have biomass burning aerosols from Indonesia

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just on the basis of Angstrom exponent that varies between 1.4 and 1.8? Doesn't sound plausible.

p 19756, l 29: Why are you considering only the cases with PW < 4.0?

p 19757, l 5: Please clarify why this discrimination is done.

p 19757, l 18: I'm not sure if all of the references are appropriate here. For example, Smirnov et al. (2011) didn't have any AOD-Angstrom scatter plots. A lot of references are given in various places, so please check that all of them are in proper places.

p 19757, l 24: "The AOD values at 500nm are normally used to indicate the turbidity condition." I don't understand what is meant by this.

p 19758, l 1: Why didn't you use Single Scattering Albedo (SSA) in the classification? You have that data from AERONET and it would improve your classifications significantly, at least for the cases with high AODs.

p 19758, l 7: Where is the reference to Table 1?

p 19758, l 16: "the indistinguishable aerosol types in the study sites were large" This is no surprise. The method you use in the classification is not sensitive to different aerosol types.

p 19759, l 5: Isn't marine aerosols coarse?

p 19760, l 11: You mention "several sources from Indochina" but couldn't the mixed aerosols be from marine origin?

p 19760, l 19: "MA was the major aerosol during the post-monsoon and northeast monsoon". Based on Fig. 3 this is true for post-monsoon but for northeast monsoon the major aerosol was urban/industrial.

Section 3.4: All the other seasons are analyzed except southwest monsoon. Why?

p 19761, l 9: "AOD_500, Angstrom440–870, and PW clearly distinguished the domi-

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nant optical properties of aerosol for each monsoonal season". I have to disagree with this statement.

p 19761, l 26: Could the number of points used explain the smaller bias in the overall dataset?

Section 3.5: There are a lot of information missing from this section. For example, what are the coefficients for the model? How was the model performance tested, what was the data used? It would be good to show the comparison in a figure.

p 19762, l 14: "The accuracy of the prediction of the AOD model was moderate" Based on what?

p 19764, l 8: "good AOD prediction" This seems to be conflicting with the previous point (p 19762, l 14). I suggest that you make a scatter plot of the measured and predicted AODs to show how well the values match.

p 19764, l 18: A single comparison with lidar data does not provide enough data to support your conclusions.

p 19764, l 28: You claim that there is a difference between the two predicted AOD values of 0.039 and 0.044. I don't believe it. The accuracy of the AERONET AODs is around 0.01 for 550 nm so I would say that the accuracy of your prediction (which is based on AERONET AOD) cannot be smaller. So it doesn't make sense to present the values with three decimals. If you use two decimals, the values are identical, 0.04. Therefore, I think that is analysis does not prove anything. Furthermore, you claim in the text that 0.044 is lower than 0.039.

p 19765, l 11: "The small group of highly underpredicted results (Fig. 5) was attributed to the significant heterogeneity of aerosols in the atmosphere (e.g., aerosol residual layers) and the large amount of high-level transported aerosol (Tan et al., 2014b, c)" This statement has to backed up with data. Previously, you mentioned that you had only one lidar measurement from this period so I don't understand what data has been

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used here.

p 19766, l 21: This lidar comparison is superficial. You should calculate AODs from the backscatter profile by assuming suitable lidar ratios. You could verify the selected lidar ratios by comparing the calculated lidar AODs with AERONET AODs. If the AODs match, your lidar ratios are ok.

Section 3.8: The comparison with other models is superficial. You only discuss R2 values. What about RMSE and biases? I would suggest to use scatter plots to show how well the models match the measurements. Moreover, present the coefficients used in the equations.

p 19768, l 10: Do you consider marine aerosols to be pollutants?

p 19768, l 19: If RH didn't play a role in the model, why was it there in the first place?

Section 4: I would suggest that you present the conclusions with values so it is easier for the reader to see how well the model performed and such.

References: Check the references for typos. For example, Smirnov (2002b) and Tan (2014c) have them.

Table 1: This isn't mentioned in the text.

Fig. 1: Printed version hard to read. Consider leaving the columns out. They don't provide much information.

Fig. 4: Printed version is impossible to read. You should have the same region in all of the plots. That would help the comparison. Why plot a) has a different scale than the others and what is the e) plot. It isn't mentioned anywhere.

Fig. 7: Printed version hard to read. What is the difference between figures 5 and 7?

Fig. 8: This figure could be left out.

Fig. 9: Hard to draw any conclusions from this figure.

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References:

Lee et al., (2010). Characteristics of aerosol types from AERONET sunphotometer measurements. Atmos. Env., 44, 3110–3117.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 19747, 2014.