

***Interactive comment on* “Secondary aerosol formation promotes water uptake by organic-rich wildfire haze particles in Equatorial Asia” by Jing Chen et al.**

Anonymous Referee #1

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Review of Chen et al. (2017) ACP

Summary

The paper presents measurements of biomass burning aerosol hygroscopicity, both fresh and with aging. This is an important region and biome to characterize for smoke properties. The paper finds a substantial difference in κ attributed to difference in the organic fraction hygroscopicity. The latter is related to aging and the fraction of water-soluble organic material. The paper is a well referenced manuscript and the methods appear sound. A few items need further attention before this publishable in ACP.

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Discussion paper



Major Comments on Content

Line 6 is it agricultural development in this region? Housing, industrial? More specifics are recommended.

Show some data on calibration in the paper or supplementary material. This is important to give the reader confidence in the findings. The reference to the first paper is a help but some indication of these efforts is merited in the paper or supplementary material.

I may have missed it, but do you apply any OC to particulate organic carbon multiplier or use as measured OC? This would be good to state up front and/or in abstract.

Relying on the publication of a manuscript in preparation for experimental details is somewhat risky (Budisulistiorini et al.).

Do you have any indication of age of the smoke aerosols that were sampled? Any characterization of the combustion characteristics of the surrounding fires (fuels, phase, etc.)? Presumably a smoldering dominated combustion situation with peat burning.

Jayaranthe et al. (2017) on the organic carbon content and WSOC of SE Asian peat-land smoke is a relevant reference to bring into your analysis.

The strength of the hygroscopic response of peat smoke organic aerosol as it ages is somewhat surprising. The assertion that wildfire haze particles are generally highly hygroscopic in the conclusion counters most of the research in the literature. Compare to the results from the Carnegie-Mellon group (e.g. Englart et al. 2012) or FLAME results (e.g. Carrico et al. 2010). Relevant fuels such as duff show little water uptake and only modest increases with oxidation ($\kappa < 0.1$) for organic carbon dominated aerosol from this sourced. Commenting on this is useful.

How is RH obtained with possible temperature changes in the system? At the high RH $\sim 85\%$ of your measurements a 1degC change in temperature results in 5% change in RH. Accessing the cited Chen et al. (2017) the RH was monitored at the inlet and

outlet of the humidified DMA. Could the temperature of the column have been different?

Related, could the diurnal variation be due to changes in sampling conditions? I find it surprising that the organic fraction hygroscopicity would change so much day to night (table 3, fig 5). More discussion as to what you attribute the changes would improve. If photochemistry and oxidation of organics is suggested is there any relationship to solar input on the days of sampling?

To what do you attribute the decrease in kappa with increasing chloride and nitrate fraction? Shouldn't these be hygroscopic inorganic species that would contribute to increasing kappa? Why would kappa increase so strongly as these ion fractions approach zero?

A relationship in figure 9 is likely but figure 8 shows little relationship (suggest dropping this and stating no relationship found). Even without Oct 22 the relationship looks weak, r^2 of 0.2 or so?

Comments on Presentation

Overall the writing mechanics is reasonable and clear but needs further work for ACPD standards. I will highlight a few passages with suggestions for better writing. I recommend further refinement with a fluent English writer to raise it to acceptable levels. Here are a few:

Line 14 change to "not only in terms of hazards to human health"

Line 16 I'm not aware of any prizes offered for poor air quality and though I'm sure the region would vie for such a title I recommend keeping magazine-like statements out of the article.

In Figure 5 I suggest either plotting d/DO or kappa and not the rainbow colors of kappa that follows the same pattern as d/DO that is plotted.

The traces in figure 6 are somewhat difficult to distinguish.

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Chemical characterization of fine particulate matter emitted by peat fires in Central Kalimantan, Indonesia, during the 2015 El Niño, Jayarathne et al. (2017) ACP.

Cloud condensation nuclei activity of fresh primary and aged biomass burning aerosol, G. J. Engelhart, Atmos. Chem. Phys., 12, 7285–7293, 2012, www.atmos-chem-phys.net/12/7285/2012/doi:10.5194/acp-12-7285-2012

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2017-994>, 2017.

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