

Author note: The long delay in addressing the Referee comments and revising this manuscript was so that we could conduct further data quality assurance. Although the re-analysis of the data has had little or no effect on the conclusions, the QA is more robust and the revised text and figures reflect this re-analysis.

Interactive comment on “Size-resolved aerosol water uptake and cloud condensation nuclei measurements as measured above a Southeast Asian rainforest during OP3” by M. Irwin et al.

Anonymous Referee #3

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“Size-resolved aerosol water uptake and cloud condensation nuclei measurements as measured above a Southeast Asian rainforest during OP3” by M. Irwin et al. The data appear to be of high quality and of high relevance for atmospheric science studies as ACP requires.

Whilst the introduction section is really good, I felt the overall manuscript is quite heavy to read. There are 12 figures in the ACPD manuscript, and 5 in the supplementary information (SI). Some of the figures from ACPD version could go to SI : for example, Figure 6 and 7 which are not key figures.

After addressing previous comments regarding Figure 6, we believe it to still be a valuable figure. However, Figure 7 is now in Supplementary Material (Fig. S5).

Figure 1 and 4 can be merged, and the legend of current figure 4 should be outside the chart.

Though Figure 1 and 4 are similar, we feel that as the critical supersaturation is a secondary-derived product of the CCNc data, that its introduction before the fraction activated figures (2 and 3) may confuse the reader. The legend has been moved to outside the chart and Fig. 4a has been removed (as it is duplicated in Fig. 1).

Figure 5 does not do a good job in summarising the message. Why not give the average GF-PFG for the whole period (and for the terrestrial versus marine if substantially different)?

In order to address comments from the previous reviews, we have produced averaged $p(GF)$ spectra for each dry diameter, now located in supplementary material. We feel that Figure 5 is useful as it shows the temporal variability in the $p(GF)$ which can be visually compared to the CCNc, AMS and DMPS measurements directly.

Figure 9 needs more explanation on why results are different.

We have added the following discussion to Page 3133, line 14: “The observed increase in the difference between values of κ with dry diameter though non-intuitive could be due to differences in equilibrium states in the two instruments (discussed below). For example, larger particles could contain more semi-volatile material than smaller particles, and should the equilibrium conditions differ between instruments (which they will), the final organic content may differ as constituents are preferentially volatilised in different ratios in each instrument. Even if the amount of semi-volatile material were the same at each size, it might be expected that any discrepancy between the actual and the equilibrium amount of semi-volatile material (including water) in the instrument at the point of measurement might vary, since the kinetics of mass transfer will change as a function of size. Furthermore, the non-ideality of the solution (i.e. activity coefficient) might change significantly between 90% RH and the point of activation, leading to changes in apparent κ between instruments, differently for differing dry diameters due to the differences in equilibrium conditions. Finally, the aerosol is mostly internally mixed for diameters below 53nm, after which the aerosol becomes increasingly externally mixed with increasing dry diameter. As κ is derived from the mean of $p(GF)$, there is a reduced impact on κ due to aerosol mixing state compared to values derived by the CCNc; which will comprise a range of κ values.”

In the discussion section, I felt there was too little comparison with other studies (Good et al. 2010a, 2010b, Irwin et al. 2010 for the most recent for example).

We have expanded the discussion comparing to the other studies, from page 3137, line 11:

“Though near-identical calibrations were performed for each instrument at each location, there are significant differences between the all results shown by the two marine campaigns presented by Good et al. (2010a,b). Good et al. (2010a) present data from a marine location, where on average the κ values from the CCNc are higher than those derived from the HTDMA, yet another marine study by Good et al. (2010b) shows NCCN (and κ) derived from the CCNc to be near-systematically underpredicted.”

And:

“Values of κ_{Sc} from moderately-polluted COPS were between 0.4 and 0.1 and values of κ_{GF} were between 0.2 and 0.08, the reverse of the results from this project; where values for the HTDMA-derived hygroscopicity parameter were larger than when derived from CCNc measurements. The consequence is that the results from COPS predicted N_{CCN} from HTDMA measurements to be lower than from CCNc measurements. The data from COPS typically consisted of N_{CCN} slopes closer to the 1:1 line, and higher R2 correlation.”

I also believe there should be an average size distribution for: whole field study, marine and terrestrial, also including average BC concentrations if data are available. BC trends could be added with figure 1 showing the organic/sulphate

ratio. I find it difficult there are only two scenarios (marine and terrestrial), was PMF on AMS organic matrix carried out and is this published somewhere else?

We have added averaged DMPS data to Figure 1 as d) day and night and e) marine and terrestrial averages. MAAP Black Carbon concentrations have been added to Figure 1b in addition to the AMS organic time series. Throughout the field measurements, five different back trajectory scenarios were observed (see Fig. 1a and cited reference Robinson et al., 2011). As shown in Fig. 1a, the data time series is dominated by marine and terrestrial sectors, and so we have focused the analyses on these time periods. Robinson et al. (2011) also included PMF in their analysis, and so it is not duplicated in this paper.

Overall, whilst the importance and the quality of the data are not remotely questioned, but a better presentation should be achieved with the figures.

We believe we have improved the readability, quality and overall presentation of the figures.