

Authors' responses to comments of Referee #2

We thank Referee #2 for the review and suggestions for improvement of our manuscript, which we will implement upon revision. Detailed responses to the individual comments are given below. The referee's comments are listed first in italics, followed by our responses in normal font.

General comments:

RC: 1. As I noted above, the CCN activity of the aerosols sampled at the site have already been reported in previous studies, involving some of the authors of the current manuscript. The authors should discuss briefly what new information this study brings on the table compared to previous studies.

AC: As clearly detailed in the abstract and conclusions section, this study presents and compares results from an intensive measurement campaign with two CCN-counters independently operated and calibrated by different groups and in different modes of operation (size-resolved and integral CCN measurement). Size-resolved CCN measurements have not been published before for this site, and such a combination and intercomparison of CCN data has previously not been available and reported for the Jungfraujoch site (and only for very few other sites). Also, we show for the first time how the CCN properties change during a precipitation event.

RC: 2. Section 3.1., first paragraph. The authors note that CCN concentrations measured by two operated CCN counters differ by around 20% on average at the lowest supersaturation applied. This is because the applied supersaturation differ between the instruments (0.099 vs 0.079%). Have the authors attempted to make a power-law fit to the CCN concentration vs supersaturation data (i.e. "Twomey's power law-fit", Twomey, 1959). This would allow for interpolating the measurements to the same supersaturation to see if the interpolated CCN concentrations would match.

AC: Thank you for the valuable hint. We fitted the $N_{CCN,tot,p}(MPI)$ and $N_{CCN,tot,m}(MPI)$ values with a Twomey power law fit ($CCN(S)=c*S^k$) according to your suggestion and obtained fit parameters of $c_p = 63.7$ and $k_p = 0.716$ as well as $c_m = 246.1$ and $k_m = 0.533$, respectively. Table 1 shows the CCN concentrations calculated with this parameterization for $S(PSI)$ and $S(MPI)$. It shows that the CCN concentration calculated by the Twomey fit assuming $S(PSI)$ agrees well with $N_{CCN,tot,p}(PSI)$, which makes clear that the differences in the CCN concentrations measured with the two CCNC can be attributed to differences in the supersaturation at which they were operated. However, it is also evident that the Twomey fit represents the measured $N_{CCN,tot,p}$ only poorly at $S=0.079\%$, whereas at all higher supersaturation levels (also already at $S = 0.099\%$) the fit is very good. This emphasizes that the CCN concentration seems to be very sensitive for the supersaturation at very low levels.

In the revised version of our manuscript we plan to include the additional information in Table 1 and in the text.

		TWOMEY-FIT		MEASURED AVERAGE	
S(MPI)	S(PSI)	CCN(S(MPI))	CCN(S(PSI))	$N_{CCN,tot}(MPI)$	$N_{CCN,tot}(PSI)$
0.079	0.099	10.3	12.2	6	13
0.17	0.2	17.9	20.1	17	20
0.27	0.29	24.9	26.3	29	31

0.46	0.48	36.5	37.7	38	40
0.66	0.67	47.3	47.8	45	48

Minor and technical comments:

RC: 1. In section 2.3.1 is stated that the sampled aerosol is heated to 298 K, while in section 2.3.2 (page 32584) it is stated that the kappa values are calculated for temperature of 303 K. Please explain.

AC: It is true that the inlet was heated to 298 K but the room in which the instruments were placed was even warmer. This led to a further increase in aerosol temperature on the way to the CCNC. For the temperature at which the activation in the CCNC takes place we used the read value of the upper TEC of the CCNC flow column (T1), which was on average at 303 K during the campaign. In the revised version of our manuscript we will add a short note on that issue in Sect. 2.3.2.

RC: 2. Section 3.1, page 32587, line 21. Table 1 instead of Table 2.

AC: Thanks for finding this typo, which we will correct.

RC: 3. Section 3.1, page 32588, line 16. See my previous comment.

AC: Thanks for finding this typo, which we will correct.

RC: 4. Section 3.1, page 32593, lines 23-24. “This results was expected...” instead of “We expected this result...”, for example.

AC: Okay, we will change that.

RC: 5. Section 3.4, second paragraph. Please give quantify the differences in kappa_p and kappa_a when comparing the hygroscopicities derived from AMS and CCN measurements.

AC: The hygroscopicity derived from AMS measurements (kappa_p as displayed as a blue line in Fig. 6a) deviated from kappa_a at S=0.079% on average by $\pm 14\%$ ($\text{abs}(\text{kappa}_p - \text{kappa}_a) / \text{kappa}_a$), with a bias of on average $+3\%$ ($(\text{kappa}_p - \text{kappa}_a) / \text{kappa}_a$). The difference between kappa_p and kappa_a for higher supersaturations was much higher (partly twice as high kappa_p than kappa_a). We will include these numbers in the revised version of our manuscript.

RC: 6. Section 4, page 32598, line 18. Omit the second “sampled”.

AC: Okay, we will delete it.