Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-875-RC3, 2018
© Author(s) 2018. This work is distributed under
the Creative Commons Attribution 4.0 License.

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Experimental study of the aerosol impact on fog microphysics" *by* Marie Mazoyer et al.

Anonymous Referee #1

Received and published: 1 November 2018

The manuscript presents a great amount of interesting fog observations (23 events examined in winters 2010-2013) in the outskirts of Paris, with an investigation of the links between (pre-fog) aerosol concentrations and fog droplet concentrations. The conclusion is that a very tiny amount of particles are "truly" activated into fog droplets (a few tenths per cm3) and, given that aerosol loadings in polluted environments amount to several thousands, a correlation between the two variables results to be rather weak. This study contributes to the existing observations (dating back to the early 90's) indicating that the majority of supermicron liquid particles in fog are actually deliquesced aerosols that have not reached the point of activation. I have, however, several major comments about the methodology used in this study.

1. One of the main conclusions is that, based on the range of hygroscopicity factors

Printer-friendly version

Discussion paper

(k) observed, aerosol composition is unimportant in determining Nact. However, the (large) error bars in Figure 9c must be considered only by keeping in mind that the k values for the SS smaller than 0.1 were determined only through an extrapolation. Nact is actually one order of magnitude smaller than the smallest concentrations measured by the CCN counter, therefore caution must be used in extrapolating the CCN data to derive hygroscopicity factors for such small subset of particles. For these reasons, I am not convinced that the scatter plot in Figure 9c provides enough evidence that hygroscopicity does not contribute to control the activation of aerosols to fog droplets.

2. The Authors present a new methodology to separate activated and non-activated fog droplets (Section 3.2 and Figure 4). This is based on an iterative calculation for matching pairs of aerosol parameters (Nccn and Dw, where Nccn was estimated by integrating the SMPS size-distributions and using the Koehler theory and the k values from the CCN measurements to derived wet diameters at the point of activation) with pairs of fog parameters (N_droplets and Dw measured by WELAS+FM) and making Nccn to converge to N_droplets. This is an interesting approach, but it is based on strong assumptions: a) it ignores that the Dw distribution in the WELAS+FM is much broader than the Dw of aerosols at the activation point because this point is reached only instantaneously and activated droplets grow to larger diameters afterwards; b) it ignores feedbacks of the activated droplets on SS so that all aerosols are assumed to activate at the same SS. In other words, the approach ignores kinetic effects, it is based on a purely equilibrium state, and neglects the variability of SS (and fog forms like inside a CCN counter where SS is externally controlled). The Authors have not acknowledged these caveats, and, in my opinion, they have not adequately presented a critical analysis of their approach. Only two examples are presented (f6 and f20 in Figure 7), where the approach seems to work, but what about other cases, such as the strange f22? For all these case, it would be very interesting to compare the present approach with alternative ones based on, e.g., mode fitting (Elias et al., 2015, etc.).

3. The method used to estimate Nact from aerosol measurements relies on the SMPS

CC BY

size-distributions. However, instrumental uncertainties in sizing and counting for particles larger than 400 nm should be taken into account. In addition, the discussion that the Authors present about mixing state is oversimplified as a certain extent of external mixing is common in polluted environments. In this referee's opinion, there is a lack of adequate online aerosol instrumentation for probing concentrations, composition and mixing state in the size range which is the most critical for fog droplet activation: that of large accumulation mode particles.

Finally, the text is plentiful of typos. The Authors must perform a careful screening of the spelling.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-875, 2018.

Printer-friendly version

Discussion paper

CC BY