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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the Relationship Between Cloud Water Composition and Cloud Droplet Number Concentration" *by* Alexander B. MacDonald et al.

Anonymous Referee #2

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This paper describes the relationship between cloud droplet number concentration (Nd) and cloud water composition using field measurements by aircraft flights off the California coast over 4 multi-years campaigns. After the chemical analyses of the cloud-water samples, the data were statistically analyzed to find the best correlations between chemical species and Nd. The results highlight the importance of sulfate (both Total and non-sea-salt) in predicting Nd and its variability, confirming findings already reported in previous studies. But the authors investigate also the role of other chemical species (sea-salt, dust, organic matter) as well as of some other factors (i.e., turbulence, cloud height, etc.). This is a very well-written paper that clearly describes measurements, statistical approach and results which are also nicely compared to previous

findings. Even the possible drawbacks of the methodology and of the dataset are well discussed by the Authors leaving no space for substantial criticism by my side. The results are of interest for a large community investigating aerosol-cloud interaction from experimental and modelling point of view and so the publication of this work is strongly recommended as it is.

I have only a question/comment (not influencing the final decision on this paper but maybe interesting for future works): have the Authors any measurements/estimations of the acidity of cloud water? pH has an important role in sulfate aerosol formation mechanism (Turnock et al., GRL, 2019), in the gas-particle partitioning of NH4 and NO3 and in solubility of metals (Pye et al., ACP, 2020). Can the Authors comment about the possibility of testing pH as a complementary predictor (maybe partially explaining the negative coefficients of some regressions)?

Pye, H. O. T., Nenes, A., Alexander, B., Ault, A. P., Barth, M. C., Clegg, S. L., Collett Jr., J. L., Fahey, K. M., Hennigan, C. J., Herrmann, H., Kanakidou, M., Kelly, J. T., Ku, I.-T., McNeill, V. F., Riemer, N., Schaefer, T., Shi, G., Tilgner, A., Walker, J. T., Wang, T., Weber, R., Xing, J., Zaveri, R. A., and Zuend, A.: The acidity of atmospheric particles and clouds, Atmos. Chem. Phys., 20, 4809–4888, https://doi.org/10.5194/acp-20-4809-2020, 2020.

Turnock, S. T., Mann, G. W., Woodhouse, M. T., Dalvi, M., O'Connor, F. M., Carslaw, K. S., and Spracklen, D. V.: The Impact of Changes in Cloud-Water pH on Aerosol Radiative Forcing, Geophys. Res. Lett., 46, 4039–4048, https://doi.org/10.1029/2019GL082067, 2019.

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