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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Characterization of Aerosol Composition, Aerosol Acidity and Organic Acid Partitioning at an Agriculture-Intensive Rural Southeastern U.S. Site" *by* Theodora Nah et al.

Anonymous Referee #1

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Nah et al. presented a detailed case study on aerosol composition, acidity, and organic acid partitioning at an agricultural rural site in the USA. The most important contribution to the current literature is the measurement and analysis of different organic acids. The manuscript is generally well written, however, the following comments should be well addressed before consideration of publication.

These observational data sets should be very useful for the researchers who are interested in the topic of aerosol acidity and organic acid partitioning (especially there are several observations still without reasonable explanations, such as the partitioning of formic and acetic acids). Thus, if possible, I suggest these valuable obser-

vational data can be made available/accessible to the research community. In fact, the journal says that "Authors are required to provide a statement on how their underlying research data can be accessed. This must be placed as the section "Data availability" at the end of the manuscript before the acknowledgements. Please see the manuscript composition for the correct sequence. If the data are not publicly accessible, a detailed explanation of why this is the case is required. The best way to provide access to data is by depositing them (as well as related metadata) in reliable public data repositories, assigning digital object identifiers, and properly citing data sets as individual contributions." https://www.atmospheric-chemistry-and-physics.net/about/data_policy.html#data_availability

Section 2.2, Lines 262-263: the unit of Haq+ should be mole kg-1 and, given the Equation 1, the pH definition is based on molality rather than molarity.

Section 3.3, Lines 424-425: it is mentioned that "diurnal variation in particle pH is driven by Wi". Can the authors provide a quantitative analysis to show the relationship in the pH and Wi diurnal variations? I feel the Wi may not be the dominant factor that affects the diurnal variation of pH.

Section 3.3, Lines 429-439: the average pH of this study is 2.2, which is 0.3 pH unit higher than PM1 pH in CalNex. The NH3 level in this study is four times compared to CalNex. A 0.6 pH unit difference is expected from the relationship of 1 pH unit increase $\sim$ 10 times increase in NH3. This manuscript attributes this 0.3 unit difference to much higher levels of sulfate and nitrate in CalNex. I think this statement is not well justified since the ambient temperature and RH in these two campaigns are also different. I suggest to provide a more thorough analysis on this pH difference or remove these sentences from the manuscript.

Section 3.4: On the diurnal variations of organic acids. Several factors (such as emission sources and photochemical production) are provided to explain the diurnal variations of the gas-phase and particle-phase organic acids. The authors seem to ignore

the role of phase partitioning on the diurnal variations of the organic acids. If the organic acids are in a gas-particle equilibrium, no matter how they are formed, they would be re-partitioned between these two phases depending on the pH value and the aerosol water mass.

Section 3.5, Lines 605-608: an increase from 81% to 89% is expected from the S curve analysis, and what are the corresponding values (εC2O4(2-)) for the observations? Do the observations support the S curve analysis?

Section 3.5, Lines 618-620: it reads from Figure S12 that there is a negative bias of εC2O4(2-) during the daytime and a positive bias during the nighttime. Can the authors provide a more quantitative analysis for the diurnal variations of εC2O4(2-)?

Section 3.5, Lines 625-627: I do not think the statement that "S curves can be used to estimate activity coefficients based on gas-particle partitioning data xxx" can be derived from the data analysis in this section. For example, in Equation 4, the relationship between εC2O4(2-) and pH depends on three activity coefficients: those of H+, C2H2O4, and C2HO4-, and this relationship is nonlinear. In this case, it seems unlikely to obtain a reasonable value for any activity coefficient.

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