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Interactive comment on "Significant contrasts in aerosol acidity between China and the Unites States" *by* Bingqing Zhang et al.

Anonymous Referee #1

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Review of "significant contrasts in aerosol acidity between China and the United States" by Zhang et al. NOTE: the title is actually "Unites" States, NOT "United" as I am sure the authors intended to write

The authors identify an important issue in atmospheric chemistry, namely the distribution in pH values across the globe and focus on 2 regions where SOx and NOx, two main contributors to aerosol acidity, are prevalent, the U.S. and China. The authors find that pH is generally higher in China than in the U.S. as a consequence of ammonia/ammonium and nitrate/nitric acid. Species focused on in this study, e.g., ammonium nitrate are volatile and are often not well described quantitatively in weekly (or longer) aggregated samples, as is characteristic of the U.S. samples used in this analysis. The authors point out that CASTNET's accuracy for most species, with the

C1

exception of NH_4+, is 'good'. I find this troubling because of the high time resolution measurements in China, to which the U.S. measurements are compared, and ammonium losses to the gas phase are a function of temperature, which changes over a week+ (U.S. measurements) and less so over and hour (China measurements). I find the lack of attention to the measurements hinders holistic interpretation of results.

For example, the authors point out that their model evaluation of partitioning ratios compares more favorably in the U.S. than in China and attribute this to "even more partitioning". They also state later in the manuscript: "On the other hand, the simulation in the United States captures the trends of almost all the components though is biased low for SO_4^{2-} and NH_4+ in summer (Fig. S6b, h). These results indicate the need for better quantification of the monthly emission trends in China which are currently subject to high uncertainty." It is not immediately clear to me that this, in fact, means monthly emission trends in China are the driver. What about reasons for biases in the U.S.?

In the abstract the authors state: "Considering the historical emissions trends, the difference in aerosol acidity between these two countries is expected to continue as SO_2 and NOx emissions are further controlled." If both countries are reducing emissions, it is not clear why this is the case when they do not provide context for this statement.

I cannot recommend publication of this manuscript in its current form.

detailed comments: Throughout the manuscript in the text and figures, the authors say "United States" and China, but more precisely mean the contiguous U.S. and Northern China Plains.

Page 15, Line 442: The authors state that emissions of NH_3 in the U.S. have remained constant. Can they provide a reference? I do not think this is an accurate statement.

Does the midline in Figure 1 actually depict the average and not the median? Statistical software often defaults to the median.

C2

Figure 4: what do the error bars represent?

Figures 10 and 12: It would be best to make the y-axis the same in each panel

There are several awkward English statement. I only list two: age 1, line 21: "adequate enough" page 8, line 226: 'reasonable justified"

C3