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Interactive comment on "Technical Note: Influence of surface roughness and local turbulence on coated-wall flow tube experiments for gas uptake and kinetic studies" *by* Guo Li et al.

Anonymous Referee #2

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Overall Evaluation. Li et al. have conducted a detailed study of the effect of substrate roughness on the outcome of kinetics studies using coated-wall flow tubes. Uptake coefficients derived from coated wall flow tubes operated at or near atmospheric pressure must be corrected for radial concentration gradients within the tube, especially when uptake to the coated wall is highly efficient. Corrections are performed using the methods of Brown (1978), CDK (Murphy & Fahey, 1987), or KPS (Knopf et al. 2015) that are by now well established. However, no study to date has taken a systematical look at the effect of substrate surface roughness and resulting turbulent diffusion effects in the analysis of coated wall flow tube experiments. The authors outline the defining variables in defining surface roughness (e.g., roughness height, relative rough-

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Discussion paper

ness, and the critical height) and describe how these parameters can be understood in the context of the widely used diffusion correction treatments. They then present a very useful method of identifying when uptake coefficients are negatively impacted by roughness-induced turbulence and provide a means to estimate the associated error in uptake coefficients due to this effect. For the most part, the approach is clear/simple to follow and the manuscript well written and presented.

Coated wall flow tubes are widely used for studying the kinetics of heterogeneous and multiphase chemistry reactions. Much of the uptake coefficient data found in the NASA or IUPAC evaluations that are used for modeling on the efficiency have been derived by this technique. When working with environmentally relevant substrates (e.g., ice, soil, mineral dust, etc.) the surface is inherently rough and practitioners (and reviewers of their manuscripts) have often speculated on the effects of surface roughness on the results. The authors demonstrate, using a handful of data extracted from the literature that such roughness effects must be considered; depending on the flow tube configuration, errors can be potentially significant. Given our dependence on accurately determined uptake coefficients in modeling heterogeneous processes, it is critical that we understand the effect of substrate roughness on the experiments used to measure them.

In my opinion, this study provides an important contribution to the literature since it will help the atmospheric community evaluate the quality of measured uptake coefficients and will provide experimentalists with a tool for designing a flow tube configuration that avoids errors due to turbulence created by surface roughness. I am highly supportive of publication. Below are a few minor comments the authors may wish to consider in revising the manuscript.

Specific Comments (listed by page: line#) 4:19: The critical height is introduced on this line, but it is only at the bottom of page 5 that we have a formal mathematical definition of the critical height. Between page 4 and 5 there is a discussion of figures that involves this critical height but an explicit definition was lacking. I would recommend

including a general/non mathematical definition of the critical height concept when it is first introduced; doing so would improve readability of section 2.1.

9:13: (Section A.2). I found this section somewhat tedious to read and not conducive to teaching the reader how to perform the calculations described. Perhaps this is due to the abbreviated format that relied on leading the reader through the flow charts in Figure A.3. I believe this section could be elaborated on in more of a tutorial fashion to increase reader comprehension and to allow the reader to more easily derive such plots themselves. In addition, the authors may wish to include a table of abbreviations in the supplementary files.

9:30: (Figure A.4). Two stacked graphs are included in figure A.4 and it took me a while to understand what they were referring to. My interpretation based on section A.3 on page 9 and the abbreviated figure caption is that the top panel refers to the condition where ideal laminar flow is considered for the various diffusion corrections, while the lower panel considers how the various correction methods break down when local turbulence in the laminar flow occurs. I recommend referring to the two panels as A and B in text and then including labels of the modeling conditions in either the graph or the associated figure caption.

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