The authors would like to thank the reviewer for the constructive comments. Our replies to the comments are given below, with the original comments in black, and our response in blue.

Anonymous Referee #1

This work documents aerosol-nucleation-rate lookup-tables generated based on the results from a kinetic model (Yu et al. 2018ACP). Four major aerosol nucleation mechanisms are considered in these lookup-tables and they cover a wide range of key parameters relevant for aerosol nucleation. The lookup-tables can be used in 3-D models to save computational cost, so they are potentially useful for other modelers who want to simply the aerosol nucleation treatment in their models.
Overall, the manuscript is well written. The documentation is clear and key information is provided.
Thank you for positive comments affirming potential usefulness of the work.

I think the work could be further improved by comparing these tables (calculated nucleation rates) with other widely-used aerosol nucleation parameterizations, so that other users can have an idea about what to expect in their model result. For example, the Vehkamaki et al (2002, hereafter V2002) binary nucleation scheme is used by many aerosol models (e.g. CAM5 Liu et al., 2012GMD, ECHAM5-HAM, Stier et al. 2005ACP, etc). How does the BHN lookup-table compare with V2002? The ioninduced aerosol nucleation is considered in the ECHAM5-HAM2 model (Zhang et al., 2012ACP), using a similar lookup-table method (Kazil and Lovejoy ,2007ChemPhys and Kazil et al, 2010ACP). How does the BIMN lookup-table compare with K2010? In addition, some aerosol models (Wang et al, 2009ACP, Zhang et al, 2012) use the nucleation parameterization for the boundary layer (e.g. Kuang et al., 2008JGR) in combination with the binary nucleation scheme. Can the THN/BIMN/TIMN schemes be used along with such boundary nucleation scheme? It would be nice to provide such information to other users as well.

This is a good suggestion. We have added discussions on the comparison of present nucleation schemes with other widely-used aerosol nucleation parameterizations.

We think that the THN/BIMN/TIMN schemes shall not be used along with empirical boundary nucleation schemes because these empirical parameterizations were derived from in-situ measurements and might be some kind of simplified parameterizations for THN/BIMN/TIMN processes in the boundary layer. To use both may lead to double count.

Other specific/minor comments:
P1L11, abstract: have -> has
Corrected.

P1L12, L30 and throughout the text: Better use either “Ion” or “ion”.
Done.

P1L25: "for BHN, THN, BIMN, and TIMN" could be deleted
Done.

P2L11: Maybe also mention the nucleation pathways involving organics?

Yes. It is now mentioned.

P4L12: Is RH the hybrid relative humidity or the RH respect to water? Please clarify.
It is the RH respect to water. Clarified in the text describing Table 1.

P4L15-24: It would be nice to provide some quantitative estimate of the lookup-table accuracy here.
Compared to those based on the full model, the deviation of nucleation rates based on the lookup tables is generally within a factor of two, well within the corresponding uncertainty of CLOUD measurements. We added a discussion on this to the text.

P4L24: Can two points for S to get sufficient accuracy?
The dependence of nucleation rates on the surface area, which serves as coagulation sink of pre-nucleation clusters, is relatively linear and two points for S provide reasonable accuracy (compared to the uncertainties in the model itself and measurements). In the atmosphere, the surface area of pre-existing particles not only serves as coagulation sink but also as condensation sink for H_2SO_4, and thus has a more profound impact because nucleation rates are highly sensitive to $[H_2SO_4]$. For the lookup tables, $[H_2SO_4]$ is fixed and therefore the dependence of nucleation rates on surface area are relatively weaker. It should be noted that most of existing nucleation parameterizations do not take into account the effect of surface area. We have clarified this in the text.

P5L1: extrapolation -> linear?

We use linear extrapolation with regard to the dependence of $Log_{10}J$ on surface area. We have clarified this in the text.

P5L21: very lower -> very low
Corrected.

P6L20: the online program (http://apm.asrc.albany.edu/nrc/) didn't work for me (both in safari and firefox). Better fix it before the final publication.
We found that sometime the calculators didn't restart automatically when the server was rebooted. This problem has now resolved and the calculators shall be online all time.

Reference

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Kuang, C., McMurry, P.H., McCormick, A.V. and Eisele, F.L., 2008. Dependence of nucleation rates on sulfuric acid vapor concentration in diverse atmospheric locations. Journal of Geophysical Research: Atmospheres, 113(D10).
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