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Interactive comment on "Heterogeneous nucleation of water vapor on different types of black carbon particles" *by* Ari Laaksonen et al.

Anonymous Referee #3

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The authors present measurements of heterogeneous nucleation of water on different types of carbon black. They tend to understand these measurements with a recently developed adsorption nucleation theory. The interesting finding is that with sufficient adsorption sites, soot particles can activate even when no soluble material is present, which is in contrast to the kappa-Köhler theory. The paper is well-written and fits into the journal ACP. However, the paper is short and eventually should be published as the new MS type "ACP Letters". Anyway, there are some shortcomings which should be discussed before publication:

Main comments

The contact angle is a rather imprecise value as mentioned by the authors (line 121-130). However, the explanation why in the case of graphite the contact angle should

be more trustable (+/-5°) is not very convincing. More arguments should be presented considering the structure, morphology and chemistry of the respective graphite type and its impact on the contact angle and on the heterogeneous nucleation.

Häusler et al. (2018) have measured the impact of graphene and graphene oxides on heterogeneous ice nucleation and found that structure, morphology and chemistry have an important impact. The authors might discuss how they can parameterize such findings for the heterogeneous nucleation of water vapor.

Niedermeier et al. (2014) have developed a soccer ball model for heterogeneous ice nucleation relying on different contact angles on the surface of a nucleus. The authors might discuss how this model compares to their adsorption nucleation theory.

Minor comments

Fig. 3: The caption of fig. 3 mentions more details in the text. However, the text does not explain how to read this figure and for what reason lnN is plotted against ln(-lnS). Fig. A1: The x-axis theta should have the unit degree (°). The label of the y-axis on the right-hand site should be deleted.

Fig. A3: The supersaturation S* should have the unit percent (%). The contact angle (theta) should have the unit degree (°)

References

Haeusler, T., Gebhardt, P., Iglesias, D., Rameshan, C., Marchesan, S., Eder, D., Grothe, H. (2018), Ice Nucleation Activity of Graphene and Graphene Oxides, J. Phys. Chem. C 122, 15, 8182–8190, https://doi.org/10.1021/acs.jpcc.7b10675

Niedermeier, D., B. Ervens, T. Clauss,J. Voigtländer, H. Wex, S. Hartmann,and F. Stratmann (2014), A computationally efficient description of heterogeneous freezing: A simplified version of the Soccer ball model, Geophys. Res. Lett.,41, 736–741, doi:10.1002/2013GL058684.

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