We thank all reviewers for useful comments. We would like to note that we found a minor bug in the program used for ANT calculations. After fixing the bug, the adsorption site distances used for calculating the coagulation nucleation curves in Fig. 4 are 4.2 and 4.4 nm instead of 3.6 and 3.8 nm. This change does not affect the discussion and conclusions in any way.

Reviewer 3

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:

> We thank reviewer 3 and would like to note that although ms is not very long, it is clearly over the 2500 word limit set for ACP letters. Our detailed replies are below.

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.

> As a matter of fact, our sensitivity analysis shows that changing the contact angle by +/- 10 degrees and the FHH A-parameter simultaneously so that the FHH model still fits measured adsorption data well, the critical supersaturation is affected by less than 1% (we changed the y-axis of Fig. A3 to match those of Figs. 4 and 5). This is much less than the experimental uncertainty of the critical supersaturations of ozonolyzed Palas soot particles (Fig. 4). We have clarified this in the text, and removed to references to +/- 5 degrees.

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.

> Häusler et al. showed the importance of graphene lattice order as well as degree of surface oxidation and surface defects on immersion freezing. Compared with vapor-liquid nucleation, freezing is impacted by possible ice epitaxy, and therefore understanding the exact surface structure is even more important than in droplet formation. Nevertheless, we now discuss structure of the Palas soot in conjunction with possible impact of capillary menisci formed between primary soot spherules to the heterogeneous nucleation (see also our reply to J.C. Corbin).

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.

The soccer ball model is intermediate between stochastic and singular (or deterministic) nucleation theories. Classical nucleation theory is based on the idea that nucleation is stochastic phenomenon whereas ice nucleation theories that assume specific temperature dependent ice nucleation sites are deterministic. The adsorption nucleation theory is deterministic as one of its premises is that nucleation occurs on specific adsorption sites, and there is no stochastic element included in the theory. Such an element could be introduced similarly as in the soccer ball model, by assuming a distribution of contact angles between the adsorption sites. However, without knowledge of e.g. the possible widths of such distributions, we prefer not to include this idea at present. Having said that, molecular dynamics could possibly be used in the future to explore this issue with chemically and physically heterogeneous surfaces. We have added these considerations in the manuscript.

Minor comments
Fig. 3: The caption of fig. 3 mentions more details in the text. However, the text doesnot explain how to read this figure and for what reason lnN is plotted against ln(-lnS).

The reason is that according to the FHH theory, multilayer adsorption data should align linearly in such a plot. This has been added to the text.

Fig. A1: The x-axis theta should have the unit degree (∘). The label of the y-axis onthe right-hand site should be deleted.Fig.

Fixed

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

Fixed

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.7b10675Niedermeier, 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.