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 2

The authors describe a new approach to parameterize the CCN activity of insoluble particles. Instead of the solute effect, they use the FHH-adsorption-isotherm to de-scribe the water adsorption on the surface of insoluble carbon black particles. The manuscript is well written and well structured. The scientific content is exciting and fills a long-existing knowledge gap. Therefore, I only have very few minor comments.

We thank Reviewer 2, our replies to the detailed comments are below

P3 L53 "as well"
Corrected.

P3 L 58 "climate active" is a bit vague. I would suggest referring to radiative forcing and cloud formation directly

New formulation: … different types of black carbon (BC) particles, which have long been known to be climate active – but with large uncertainty on their impact direct radiative forcing and on cloud formation and lifetime.

P7L130 It is a bit confusing when you say "droplet". Does this refer to a single droplet or to the water patches on the material

It refers to a single droplet growing on a BC particle. We have changed the sentences as follows: A single droplet on a BC particle grows along the red curve 1 until it reaches the critical supersaturation S_{cl}* and nucleates. However, if there are several similar droplets growing on the particle, and the average distance between them is small enough so that they coalesce to form a uniform liquid film at sufficiently low saturation ratio…

P11 L204 (Aria et al., 2016) investigated the wettability of graphene after exposure to ambient air. While this can be presentative for certain aspects of atmospheric black carbon particles, it should not be taken as an example for an atmospheric aging process. To point out, that exposure to atmospheric condition increases the interaction of black carbon with water, the following studies should be considered as an additional reference

Tritscher, T.; Jurányi, Z.; Martin, M.; Chirico, R.; Gysel, M.; Heringa, M. F.; De-Carlo, P. F.; Sierau, B.; Prévôt, A. S. H.; Weingartner, E.; et al.Changes of Hygroscopicity and Morphology during Ageing of Diesel Soot.Environ.Res.Lett. 2011, 6 (3), 34026. https://doi.org/10.1088/1748-9326/6/3/034026. Grimon-prez, S.; Faccinetto, A.; Batut, S.;

Wu, J.; Desgroux, P.; Petitprez, D. Cloud Condensation Nuclei from the Activation with Ozone of Soot Particles Sampled from a Kerosene Diffusion Flame.Aerosol Sci.Technol.2018, 52 (8), 814-827. https://doi.org/10.1080/02786826.2018.1472367. Friebel, F.; Mensah, A. A. Ozone Concentration versus Temperatureâ˘A´r: Atmospheric Aging of Soot Particles. Langmuir 2019, 35 (45), 14437−14450. https://doi.org/10.1021/acs.langmuir.9b02372

We have added these references.