

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2022-581

Anonymous Referee #1

Referee comment on "Physicochemical properties of charcoal aerosols derived from biomass pyrolysis affect their ice-nucleating abilities at cirrus and mixed-phase cloud conditions" by Fabian Mahrt et al., Atmos. Chem. Phys. Discuss.,
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This manuscript presented ice nucleation properties of biomass burning generated charcoal particles and how the physicochemical properties affect their ability to form ice. Ice nucleation and related ice nucleating particles in the atmosphere are still poorly understood. This study measured the ice nucleation activity of charcoal particles at different temperature ranges. It provides additional new data sets and also a possible nucleation pathway for these particles. The scope of this manuscript is suitable for this journal. A few issues and comments need to be considered before publication.

Comments:

- Line 162 and Line 212, How is temperature uncertainty of 0.1 K determined? Temperature uncertainty stated here for both of the setups might have been underestimated especially at low temperatures. The uncertainty of the temperature sensor its own could have already ± 0.1 K? Any consideration on the temperature variations and distribution inside the flow tube in such large device?
- Figure 1, do you have any blank measurements of pure water droplets or aqueous inorganic salt droplets?
- Line 182, Does the OPC measure the ice crystals? How long does it take to grow to a 1 μm size ice crystal? The residence time is only 10 seconds. Is it sufficient to grow ice crystal at such low water vapor pressure and low temperatures? I would guess the OPC operates at room temperature, it measures the size of droplets from the melting of ice crystals? How do the temperature and RH affect the size of droplets or ice crystals in the tube when they transport from the HINC to OPC? Evaporation or melting during the transportation.
- L284, change "immersion freezing experiments" to "freezing experiments" or "ice nucleation experiments" since you do not know if the ice nucleation is through homogeneous or heterogeneous nucleation.
- L315, How do these ice nucleation onsets for charcoal particles at low temperatures compared to other biomass burning aerosols?

- I do not follow the reasoning that the ice nucleation activity of the charcoal particles at cirrus temperature regime is result from PCF. Different ice nucleation ability of particles at different temperature ranges, immersion freezing and deposition mode nucleation, can simply because the presence of liquid water changed the active sites.
- It would be helpful if the manuscript briefly describes the different types of isotherm in section 3.2 or SI. This is important to reader to gain a better understanding on the distribution of different micropore or mesopore in these charcoal particles.
- Figure C1, what are the length of the scale bars?