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Interactive comment on "Volume nucleation rates for homogeneous freezing in supercooled water microdroplets: results from a combined experimental and modelling approach" *by* M. E. Earle et al.

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The authors would like to thank Dan Murphy for his constructive comment, which we address below.

As stated on page 22896 of the manuscript, the model runs were performed under the assumption that the temperatures of the particles (liquid and ice) were equal to that of the ambient gas; that is, that the particles were in continual thermal equilibrium with their surroundings. This was based on previous work by Chelf and Martin (2001), who

reported that under conditions relevant to their experiments in laminar flow tubes, the change in particle temperatures due to evaporation or condensation/deposition was within 0.01 K.

That being said, we did not consider the implications of even a small temperature difference on the values of the mass accommodation coefficients in this study. In a typical experiment in our flow tube, only a small fraction of the droplets freeze. For instance, Fig. 7 in the manuscript indicates that in an experiment performed using medium droplets (mode radius of 1.7 μm) at 235.7 K, the number fraction of droplets nucleated is approximately 0.04. Thus there are many more droplets than ice particles. The evaporation from droplets is much slower than deposition on ice, so the droplet temperatures will not be affected under the conditions of our experiments. Even at lower temperatures, where the numbers of droplets and ice particles become comparable, the lower partial vapour pressure of water limits evaporation and condensation rates, and the droplet temperatures will not be affected.

Given the more rapid rates of deposition, however, the ice particle temperatures could be warmer than the surrounding gas. To assess the influence of such temperature differences on the deposition and evaporation coefficients, a series of sensitivity tests were performed using the microphysics model. In these tests, the ice particle temperatures were increased by 0.1 K and 0.3 K relative to the ambient gas for each group of small, medium, and large particles discussed in the manuscript. For the 0.1 K temperature increase, the evaporation and condensation coefficients varied by less than 13% and 6%, respectively, of their values assuming thermal equilibrium with the surrounding gas. For the 0.3 K increase, these coefficients varied by less than 12% and 19%, respectively, of their values from previous model runs in which the ice particle temperatures were equivalent to that of the ambient gas.

The temperature changes considered in the sensitivity tests exceed those reported by Chelf and Martin by an order of magnitude. Based on the results of these tests, we suggest that the inclusion of heat transfer in the microphysics model will not significantly change the values of the evaporation and deposition coefficients reported in the manuscript. Moreover, the values reported in Table 1 of the manuscript are quite consistent across a range of initial droplet sizes and experimental temperatures, and produce the best fits to our experimental size distributions as compared against earlier model simulations in which these coefficients were fixed and larger in magnitude.

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