

We thank Dr. Z. A. Kanji for raising this topic, which we will address in this reply.

The major reason for testing Clay Minerals Society kaolinite (KGa-1b) and China loess soil dust in the present paper were twofold; 1) to compare the ice nucleation properties of a typical clay mineral particle and a typical natural soil dust particle to those of the agricultural soil dust particles, and 2) to show the treatments to remove/deactivate organic matter had a very small impact on the ice nucleating ability of clay mineral and natural soil dust particles. As we note, the ice nucleating ability of the kaolinite, as measured by the Colorado State University CFDC, is in reasonable agreement with what we measure for the agricultural soil dusts when organic matter is removed/deactivated. Through comparing to previous literature data, we show that the ice nucleating abilities of the natural and agricultural soil dusts without any treatments, as measured by the CFDC, are quite similar to those of natural soil dusts measured using a cloud chamber (Niemand et al., 2012) and those of agricultural soil dusts measured using a droplet freezing technique on a cold plate (O'Sullivan et al., 2014). Nevertheless, it should be noted here that the use of the CFDC for measurements is the constant factor in our studies, while the other literature data are shown for reference only.

While the intention of our paper was not to focus on how we measure ice nucleation from any particle types in comparison to other methods, we will now include a comparison for Clay Minerals Society kaolinite (KGa-1b) results for the interest of others. In Fig. A1b of the revised manuscript (see the attached figure), we compare our kaolinite fit for ice nucleation active site density (n_s) with other results in the literature (Murray et al., 2011; Kanji et al., 2013; Wex et al., 2014). Murray et al. (2011) applied a droplet freezing technique on a cold stage. Kanji et al. (2013) reported immersion freezing for polydisperse kaolinite particles using the IMCA-ZINC device combination. Wex et al. (2014) studied immersion freezing for 300 nm kaolinite particles using both the LACIS and CFDC. Also, Murray et al. (2011) estimated the n_s values based on surface area determined using the N_2 gas adsorption method, whereas all other studies report the n_s values based on geometric surface area. Murray et al. (2012) noted that the gas adsorption method would produce smaller n_s values than the geometric surface area (e.g., four times smaller when using 800 nm particles). We may note that the n_s values from our study, Murray et al. (2011) and Wex et al. (2014) are relatively similar to each other. On the other hand, the n_s values from Kanji et al. (2013) are almost comparable to those of all other studies at around -36°C , but show much higher values at warmer temperatures. Differences in the n_s values of the kaolinite between Kanji et al. (2013)

and the other studies may reflect some combination of instrumental- and/or dust aerosol generation-related factors, although the prime source is not yet known. How the method for immersion freezing used by Kanji et al. (2013) would see differences between agricultural soil dusts and other types examined here, we cannot say. Extended discussion of these points within our report would not seem to be productive for focusing on the key point of the research.

To briefly describe these points, we have added the following sentences in the main text:

Page 9710, Line 12: “The n_s values for the kaolinite presented here are relatively similar to those reported by Murray et al. (2011) and Wex et al. (2014), but are more than one order of magnitude lower than those reported by Kanji et al. (2013) at temperatures warmer than about -30°C despite the use of the same Clay Minerals Society kaolinite (Fig. A1b). The difference may be related to different experimental technique; however, further speculation concerning this issue is beyond the remit of this study and is not pertinent to the major conclusions drawn from the comparison of our experimental results obtained using the CFDC.”

Then, we have removed some statements regarding the comparison with the ice nucleating ability of clay minerals:

Page 9706, Lines 12-13: “to almost the same level as that of clay minerals (e.g., kaolinite)”

Page 9710, Lines 11-12: “and other clay minerals (e.g., montmorillonite, Atkinson et al., 2013)”

References

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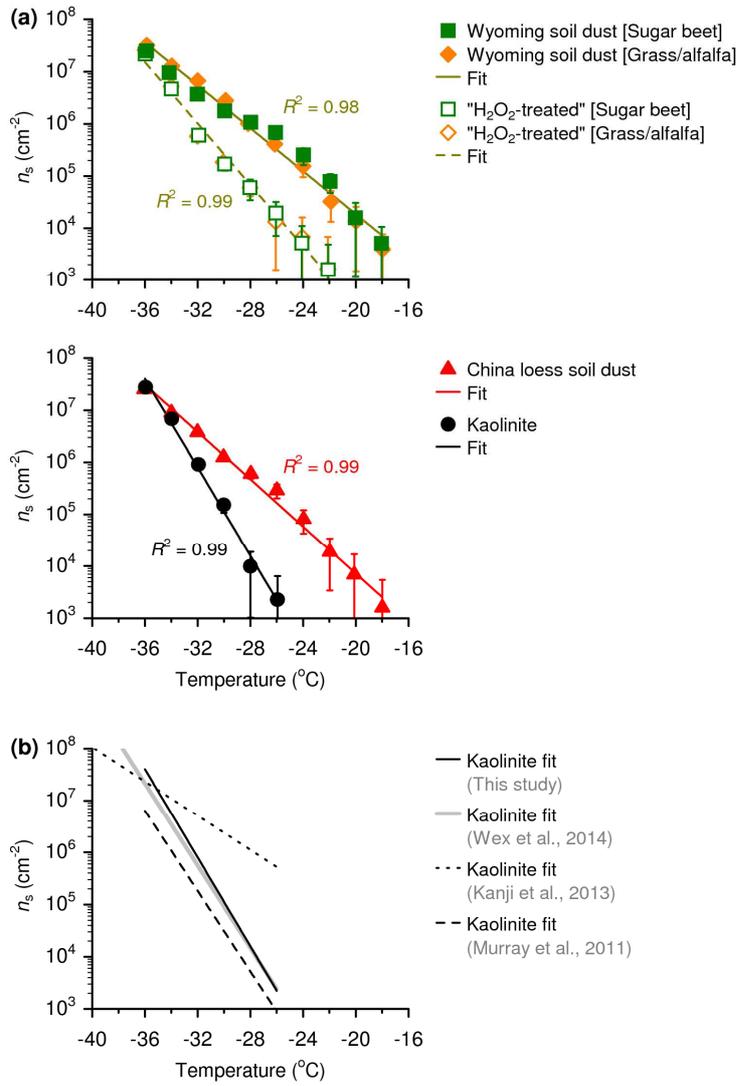


Fig. A1. Fit to ice nucleation active site densities for various dusts. **(a)** Parameterizations of n_s for untreated agricultural soil dusts ($\ln(n_s) = -0.4736T + 0.3644$; validity range: $-36^{\circ}\text{C} < T < -18^{\circ}\text{C}$) and for H₂O₂-treated agricultural soil dusts ($\ln(n_s) = -0.6773T - 7.8436$; validity range: $-36^{\circ}\text{C} < T < -22^{\circ}\text{C}$). Parameterizations of n_s for untreated China loess soil dust ($\ln(n_s) = -0.5230T - 1.5767$; validity range: $-36^{\circ}\text{C} < T < -18^{\circ}\text{C}$) and for untreated kaolinite ($\ln(n_s) = -0.9803T - 17.7764$; validity range: $-36^{\circ}\text{C} < T < -26^{\circ}\text{C}$) are also shown. Error bars represent standard deviations. **(b)** Comparison of the n_s parameterizations for kaolinite from this study, Murray et al. (2011), Kanji et al. (2013) and Wex et al. (2014).