

## ***Interactive comment on “Marine and terrestrial influences on ice nucleating particles during continuous springtime measurements in an Arctic oilfield location” by Jessie M. Creamean et al.***

### **Anonymous Referee #1**

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Review of “Marine and terrestrial influences on ice nucleating particles during continuous springtime measurements in an Arctic oilfield location” by Creamean et al. The authors report measurements of ice nucleating particles (INPs) over the period of 3 months in the Arctic during spring. Data from 17 days are presented. Since there are few measurements of INPs in this region and INPs are important for predicting climate, the measurements are certainly valuable. However, most of the conclusions reached by the authors are not well supported by the current analysis. The authors have a nice data set, but a more rigorous analysis is needed to support the conclusions in this manuscript. Specific comments are included below.

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#### Comments:

Abstract. The authors state that the concentrations of coarse mode INP at -15 C were low during the first part of the campaign but then increased by nearly 2 orders during late May. To better illustrate these results, please use a log scale in Fig. 4 to represent the INP concentrations. Currently, the changes in INP concentrations at -15 C are not clear in Fig. 4 due to the use of a linear scale to represent all freezing temperatures.

Abstract. The authors state that the higher concentrations were attributed to air masses originating from over sea ice leads and tundra surfaces. This conclusion was mainly based on back trajectories and information on snow and ice coverage in the Arctic. Although reasonable, the analysis was not very rigorous. The authors did not rule out anthropogenic pollution from local sources. This should be done in a rigorous and quantitative manner if the authors want to claim the INPs are from natural sources.

Section 1.2 (Sample collection). For INP analysis, particles were deposited on Vaseline-coated Mylar. Could the Vaseline influence the INPs and shut off freezing of some of the INPs? Were all INPs extracted from the Vaseline coating? Since this is a new approach and Vaseline could cause artifacts, the influence of Vaseline on INP concentrations should be discussed.

Page 8, lines 19-21. The authors refer to previous studies to suggest that they had relatively clean conditions around late May. But the references are from different years. Hence, these references may not precisely apply to the current study. The authors need to prove that late May was associated with relatively clean conditions. This is not obvious from Figure 2. This is especially important if the authors want to claim the INPs are from natural sources.

Page 9, line 11. The larger spread in INP concentrations could also be due to just a larger variation in source strength.

Page 9, line 28-29. “particles that are theoretically thought to be too small to serve as

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efficient INPs.” I do not think these references presented a theory that suggested that small particles are not efficient INPs. There are also several laboratory studies that show INPs can have sizes similar to the ranges isolated by stages C and D.

Page 10, line 6-8. The authors suggest that the back trajectories (Figure 6) illustrate that the transport was slow and remained near the surface. However, there is no information on trajectory height or time in Figure 6. I suggest that Figure 6 be modified to include height information and time information to support the author’s claims. Also, the trajectories go outside the plotting area in Figure 6. I suggest that the plotting area be increased so the full trajectories can be observed.

Page 10, line 13-15. “Air reaching Oliktok point originated from over a large area of open leads within 30 km off the coast of Utqiagvik (Figure 6d).” This point is not clear from Figure 6d. Where are the open leads in Figure 6d?

Page 10, line 15-16. “sources were generally regional in nature. . .” This statement is not well supported. As the authors point out, mineral dust can be transported to the Arctic from long distances [Stone et al., 2007]. Perhaps the INPs measured by the authors were mineral dust containing biological material transported from long distances? I do not think this was ruled out. If the authors want to rule out long-range transport than more information and discussion is required.

Page 12, lines 1-5. “We present the first INP measurements in an Arctic oilfield location and demonstrate how local and regional transport from marine and terrestrial sources to an industrial region can introduce high concentrations of coarse, warm temperature INPs that are possibly of biological origin.” The authors have not ruled out adequately local industrial emissions as the source of INPs. If they want to claim that the sources were local marine and terrestrial, more analysis is required to rule out local industrial emissions. For example, does the INP concentrations correlate with tracers of industrial emissions?

Figure 4. As mentioned above, I suggest using a log scale to illustrate the INP con-

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centrations. Currently it is very difficult to follow the trend at -10 C and -15 C due to the linear scale. Also, what is the onset 99th percentile, how was this calculated, and why is it different from the measured onset temperature? Is the measured onset temperature or the onset 99th percentile more relevant? Also, Figure 4 doesn’t include error bars. Error bars should be included, otherwise it is hard to tell if the trends are statistically significant.

Figure 27, a, b, c. Why only include SEM-EDX results from the end of May? Results from the first part of May would be very useful to interpret the INP data.

Figure 7, panel e. I suggest a separate panel for the wind speed and direction. Currently the panel is congested.

Figure caption 8. “Additionally, the bars and whiskers represent INP concentrations at temperatures in Table 2 and at all temperatures, respectively.” What temperatures from Table 2 are plotted? What was plotted in the case of “none” in Table 2? Please include this information in the figure caption for clarity.

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