

## ***Interactive comment on “The vapor pressure over nano-crystalline ice” by Mario Nachbar et al.***

**Anonymous Referee #2**

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The vapor pressure over nano-crystalline ice

This is a generally solid manuscript that describes new measurements of the vapor pressure of ice at low temperatures. I recommend publication with some revisions.

The most important is that in a number of places in the manuscript that language should be changed to say that the data are consistent with nano-crystalline ice, not that the data support or prove nano-crystalline ice. There are no data to directly show that the ice contained nano crystals. There are other possible explanations for the vapor pressure being elevated over that of hexagonal or stacking-disordered ice. In particular, some disorder within the stacking planes, as well as between them, could easily account for the change in Gibbs energy. Or the vapor pressure difference could indeed be from nano-crystals. Without direct evidence, the language in the paper is too certain of one explanation. This is especially true for the abstract but occurs elsewhere

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as well. I think that Figure 3 could be eliminated and replaced with a short calculation: the crystal sizes inferred from the vapor pressure difference are consistent with the previous literature.

Something that could be made clear is that the ionization gauge is measuring a pressure that is different than the vapor pressure. In free molecular flow the water partial pressure in the warm part of the chamber near the gauge is not the same as the partial pressure above the sample, but rather differs by a factor of  $\sqrt{T}$ . It is only by normalizing to the vapor pressure of hexagonal ice with the same temperature gradients in the chamber that the correct measurement is made. This is rather vague in the manuscript/supplemental material.

Two questions where I am curious, not necessarily requiring changes:

I'm curious about the stability of nano-crystalline ice. Surely there would be a distribution of crystal sizes. If the vapor pressure is controlled by surface curvature, then there would be a Bergeron process and the larger crystals would grow at the expense of smaller ones, and the vapor pressure would slowly decrease.

I'm curious why, with both a residual gas analyzer and an ionization gauge available, the authors chose to use the ionization gauge to monitor the water vapor rather than the RGA water signal.

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