

## ***Interactive comment on “Time-dependent freezing rate parcel model” by G. Vali and J. R. Snider***

**Anonymous Referee #1**

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Review of “Time-dependent freezing rate parcel model” by Vali and Snider

There are still many uncertainties in the knowledge and understanding of ice nucleation, and how to interpret laboratory measurements and observations regarding ice nucleation. In this paper, based on laboratory measurements, the authors include a time dependent ice nucleation parameterization in a parcel model to determine the importance of this time dependence for different conditions an air parcel can encounter (i.e. cooling rates).

This paper is well written, and is of interest for advancing the knowledge of ice nucleation and should be published. I have only minor comments.

Page 29306: Line 4: Suggest rewriting “...includes a period of time when the parcel remains stationary at ...”

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Line 22: “...due to lack of tools to study ice nucleation processes on a molecular scale.” As far as I understand, there is research being conducted to study ice nucleation on the molecular scale (for example see <http://research.chem.psu.edu/mafgroup/Research.html> or <http://econos2014.sciencesconf.org/36079/document>).

Perhaps the sentence can be rephrased. “.... due to difficulties in studying ice nucleation processes on a molecular scale”

Page 29307: Line 5: Please add citations for the statement that immersion freezing is the dominant mode

Line 27: suggest rephrasing: “... as additional parameters in newer parameterizations (Li and Penner.....”

Page 29308: Line 21: I suggest using capital D in Time-Dependent Freezing Rate (TDFR)

Page 29309: Line 10: “or” instead of “of”

Line 12: “Initial conditions”

Page 29310 Line 16: “indicates” instead of “indicated”.

Page 29311 Line 19: I suggest that Eq 5 is described before making references to this equation in this and the next paragraph. Page 29312: Line 9: Suggest rephrasing: “...are considered when located at considerable heights ....”

Line 10: “above”, instead of “about”.

Line 18: I suggest including a reference to Knopf and Alpert 2013 (A water activity based model of heterogeneous ice nucleation kinetics for freezing of water and aqueous solution droplets, Faraday Discussions, 165, 513), who also show the effect of cooling-rate on freezing.

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Page 29313: Line 20: I suggest defining  $T_s$  here (as isothermal level) instead of at line 2 on page 29314.

Page 29314: Line 3:  $N(s-dt)$ : number of what? Line 5: What does 1 stand for for  $p_1$  and  $q_1$  ? Line 6: is this notation correct:  $-20\text{ C} > T_s < -16\text{ C}$  ? Line 24: Should  $w = 1$  have units of  $\text{C min}^{-1}$  ?

Page 29315: Line 2: not sure what is meant by: " and some other value" Line 8: Since  $q_w$  is sensitive to the updraft velocity, does that mean that  $q_w$  is also equally dependent on the cooling rate?

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 29305, 2014.

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