Reply to reviewer's remarks on the manuscript by Khvorostyanov and Curry "Parameterization of homogeneous ice nucleation…", acp-2012-97

The authors are very grateful to reviewer for careful reading the manuscript, his huge work with verification of all equations and corrections of misprints, and several useful remarks that allowed to improve the paper and clarify the text.

The authors are grateful for recommendation of the manuscript for publication. All the reviewer's remarks are accounted for exactly as reviewer recommended and the corresponding corrections are made in the paper. Our point-by-point response to all remarks follows.

Specific (inclusive technical) comments.

1) p. 6747. Units of $J_{hom,0}$ are added. Temperature in Celsius is introduced.

2) Typo after eq. (23) is corrected.

3) p. 6752. Notations are corrected, units are added.

4) p. 6753. Notations for ρ_v, ρ_{is}, ρ_{ws} are corrected.

5) p. 6753. The reference to KC05 is added, along with the phrase:
"Formation of drops is not considered in this work and the term I_{con} is absent in eqs. (8a,b). However, both s_w and s_i are required for further consideration since ice nucleation is governed by s_w, and crystal growth is governed by s_i."
This clarifies the situation considered.
The expressions for Γ_2 and Γ_{12} are given in eq. (8c).

7) p. 6754, eqs. (12), (13). References to Fuchs (1959) and Sedunov (1974) are added.

8) eqs. (14)-(16). Is added "with constant ρ_i, ρ_{is} during the relatively short time of integration,"

9) p. 6755, eq. (17), (18a). Yes, it is possible to introduce two activity spectra, by T and s_w, the method described by the authors allows to do that since these dependencies are separated. This is done now after eq. (52a), the equations for the activity spectra by sw and T are added in eqs. (52b), (52c). For derivation of the general expressions, we use a simpler equation for activation spectrum in (18a).

10) p. 6755. Dependencies of $R_{f,hom}$ on T and s_w are considered later. Here, we give just general expressions.

11) p. 6755. Reference to section 3.2 for definition of $J_{f,hom}$ is given after eq. (18b). Eq. for $J_{f,hom}$ is given not here but in section 3.2 because several transformations of this equation are considered there. If to move eq. for $J_{f,hom}$ here, reading section 3.2 would be difficult.

12) Subscript is added in eq. (18d).

13) "as employed…" is added.

14) The effective radius is introduced in eq. (20) as suggested by reviewer.

15) OK.

16) Yes, spare dt_0 is deleted.

17) Yes, there was a typo in eq. (25) while the correct source ψ_{fc} was given 4 lines later. Reviewer made a correct remark here, but suggested the expression for ψ_{fc} that is different from ours. Following reviewer's remark, we added a notation for the source term ψ_{fc} directly in eq. (17), corrected (25) and slightly shortened the text after.

18) Ordinate in Fig. 1a is corrected.

19) p. 6759. Yes, the definition of the critical supersaturation is important here. It is added now on this page.

20) The notations are changed as "ΔM_v, and the relative amount, or percentage of condensed ice, Fr_{con},". The term "mass of ice supersaturation" is deleted.

21) OK

22) The following clarification is made before eq. (30):
"The crystal nucleation rate $R_{f,hom}$ (Eq. 18d) in a polydisperse aerosol can be simplified and is obtained by differentiating of Eq. (29) by t:"
Thus, no long derivations or new assumptions are needed, just differentiation by t of the preceding equation. The differential in (30) is replaced with dr_a. Subscript of $N_{c,hom}$ is corrected.

23) Notations are added as requested.

24) OK

25) OK

26) Notations are corrected around (37a), spare notations deleted (were moved to after (31)).

27) OK

28) OK

29) Yes, it is better to write as $J_{f,\mathrm{hom}}(T,s_w)/J^{(0)}_{f,\mathrm{hom}}(T,s_w=0)$. This is done now in caption for Fig. 8 and on page 6768.

30) u is replaced with u_s.

31) A comment on the initial time $t_0 = t_{cr} = 0$ is added after Eq. (45).

32) p. 6769, line 12. Yes, typo. The eqs. numbers are corrected, (8a), (8b).

33) Eq. (47c) is slightly refined, so that it is valid for any $t_0 = t_{cr}$, not only for $t_0 = 0$, since it includes the difference of s_w and $s_{w,cr}$.

34) OK

35) G is replaced with G_n in (49).

36) OK

37) OK

38) $N_c(s_i)$ is replaced in (55) with $N_c(s_w)$.

39) Typo in Eqs. (59), (60c) is corrected, superscript is "3".

40) a) superscript in eq. (A1) is corrected. Equation for B_i with ref. to (58) is added in the 1st line. Equation numbers from Gradshteyn and Ryzhik (1994) are added in all references.
b) Typo in eq. (A9) is corrected.
c) Reference to Ψ_1 after (A.19) deleted.
d) Misprint in eq. (29) is corrected.
e) subscript "I" at β is deleted.

41) OK.

42) Typo on p. 6775, line 1 is corrected.

43) and 44) OK

45) Reference to Ghan et al. (1993) is included, somehow it has been missed in the refs. list by the authors and editors.

46) OK

47) Eq. (77) is corrected as suggested by reviewer, with ρis and y'_i instead of $s_{i,cr}$. As reviewer noticed, this removes typos but does not change the next eq. (78).

48) Subscript "s" is added in (78).

49) Typos in eq. (79) are corrected.

50) Derivation of Eq. (80) is slightly extended and a comment is added after (80) "that $(t_m - t_{cr,1}) >> \beta^1$ and $\beta(t_m - t_{cr,1}) >> 1$ according to Eq. (54).", which explains this approximation.

51) A comment is added before (81), "using the approximate equality $s_{i,max} \approx s_{i,cr}$ due to small variations of $s_{i,max}$ discussed above,". Subscript "s" is added at u in (82).

52) The employed times on this page are t_{max}, $t_{cr,1}$, and $t_{cr,2}$. They are different for all runs and we do not consider here their analytical expression, not needed. The references to Figs. 2,4,6,7 explain what is meant here. We slightly refines description to make it clearer.

53) OK.

54) Subscript "i" is added in (86) for B.

55) Some more comments are added in derivation of (88). Subscript "i" is added for B.

56) Typos are corrected in (86), but note that we write this eq. as $\sim (c_{1i}w)^{3/2}$, and not as reviewer assumed, $\sim(c_{1w}w)^{3/2}$, therefore the final equation contains the factor $(c_{1w}/c_{1i})^{1/2}$, different from what reviewer derived.

Besides, the factor $(1+s_{i,cr})s_{i,cr}$ is moved from $K_{i,dif}$ to N_c, which is more physical.

57) OK

58) We carefully checked again derivation of eq. (91). Typo in the first line of (91) is corrected, the final equation is correct.

59) OK

60) ξ_d is replaced with ξ_{dep}.

61) Subscript “i” is added at B.

62) OK. The factor with $s_{i,cr}$ is moved from the coefficient to Nc.

63) OK.

64) Misprint in (96) is corrected.

65) Ref. to MacKenzie is corrected. Correct spelling is MacKenzie, not McKenzie.

66) Reference to Jensen et al. (1994) was added along with references to all other models participated in CPMCP.

67) The reference list was checked as reviewer recommends. Several references were added related to the equation of state, numerical models, general review papers on water and ice properties.