Review 2: Macroscopic water vapor diffusion is not enhanced in snow

Dear Authors,

The revised version of this paper has significantly improved over the first version and I thank the authors for incorporating the necessary improvements suggested by Dr. Kevin Hammonds and me. The authors have chosen to focus on arguing and showing that the phenomenological vapor transport is not enhanced. In view of this goal I think the authors have done an excellent job, especially on the discussion of their work in relation to existing literature.

A few suggestions:

- Since it is a controversial topic it is important to be as clear as possible about how this work relates to previous works, including the TCD paper of Andrew Hanson Hansen [2019]. This paper has been part of the scientific attempts to explain vapor transport in snow. I would suggest to include a small discussion on this paper in the introduction or in the discussion.
- Consider also discussing **?**. They use higher values of D_{eff}, how would their results change? Do they have to redo their simulations?
- l.85, The question related to the Yosida experiment might be the following: Is Weighing the different compartments not a flawed way of measuring the total vapor flux? For this you have to know the exact ice matrix. Because vapor and advective ice mass are connected, the advection of the ice matrix in the opposite direction should be subtracted. That the advective ice is important is also given by the alternative prediction of the vapor flux in **?**, where they equate the advective ice to the opposite vapor flux and get a an estimate that is close to the flux which was found based on the FE-based saturated vapor concentration flux.
- l.86, The word 'tempted' is suggestive, consider: If you adopt the hand-to-hand mechanism such as Hansen [2019] and . . . . Be specific rather then suggestive.
- l.104. suggestion: 'and in particular if they are, on average, larger than . . . '
- Consider including appendix A inside your main text. First it proves that D_{eff} is maximal under infinitely fast kinetics, and is in fact equal to completely saturated condition (In the robin boundary condition such as used in Kaempfer and Plapp [2009] this limit is well defined). Then you proof that it is smaller than equation 8.
- The parameter ϕ is usually assigned to the ice volume fraction, it might therefore be helpful if you state that when you define it, for example: 'not to be confused with ', and restate that in your appendix when you re-derive the equations of Hansen and Foslien [2015].
- Appendix C: I did not have time to check all the volume fraction terms in comparison with Hansen and Foslien [2015], sorry for that. Maybe double check that there are no mistakes there. One question here: why is the tabular flux weighted by the ice phase and the laminar one by the vapor? Also it might be interesting to check what the origin is of this ϕ difference term, is it only the hand-to-hand mechanism? or does it come from different definitions of averaging?

- The brackets $<,>$ look funny, rather use $\langle c \rangle$. (\left > and \left >).
- word usage: preponderant? Use simpler words whenever possible. Consider deleting this sentence, since this is discussed in your paper, but is not a result of your paper.
- The general word ‘indeed’ sounds very odd in a few places and is sometimes confusing, and rarely used in the beginning of a sentence. Please check the meaning of these sentences. For example l.494, you can avoid using Indeed, by: ”Both Trabant and Benson (1972) and Sturm and Johnson (1991) already pointed out the importance of...”
- l.7 – l.508 condensation is not replaced by deposition as you suggested you would do.
- last sentence of the conclusion: This is way to strong... you can’t know that this is the only way, there might be other approaches that you haven’t explored, please don’t overstate.

In closing I would like to congratulate the authors on a very interesting paper,
with kind regards,

Quirine Krol

References

A. Hansen. Revisiting the vapor diffusion coefficient in dry snow. *The Cryosphere Discussions*, pages 1–27, July 2019. ISSN 1994-0416. doi: 10.5194/tc-2019-143.

A. C. Hansen and W. E. Foslien. A macroscale mixture theory analysis of deposition and sublimation rates during heat and mass transfer in dry snow. *The Cryosphere*, 9 (5):1857–1878, Sept. 2015. ISSN 1994-0424. doi: 10.5194/tc-9-1857-2015.

T. U. Kaempfer and M. Plapp. Phase-field modeling of dry snow metamorphism. *Phys. Rev. E*, 79(3, Part 1), 2009. ISSN 1539-3755. doi: 10.1103/PhysRevE.79.031502.