

#### Author comment to Anonymous Referee #4

We thank Reviewer #4 for his/her review. The comments along the TCD manuscript have been taken into account. We answered to the specific points below.

8-1 Any arbitrary position vector or directed line segment? Define  $r$  more clearly!  
 $r$  is an oriented vector. We improved its description.

8-2 Only  $l_{cz}$  is the vertical component. This sentence could imply for all three.  
Modified

9-1 G? This appears to be a typo.  
Modified

11-1 What is this?  
 $l$  is the side length of the representative elementary volume. We clarified this in the manuscript.

12-1 But what are they representing? Saying they are periodic vectors tells me nothing. Although they must have units of length.  
The  $\mathbf{t}_i$  and  $\mathbf{t}_a$  vectors correspond to the temperature fluctuation at the pore scale induced by a given macroscopic gradient of temperature, in the ice and air phase, respectively. We modified the explanations of the effective thermal conductivity computation in order to be clearer.

13-1 This tells me nothing about what  $\mathbf{b}$  represents!  
The  $\mathbf{b}$  tensor characterizes the variation of the fluid velocity at the pore scale induced by a given pressure gradient. We modified the explanations of the permeability computation in order to be clearer.

13-2 What does  $\text{resp.} < 1$  mean? In fact these (resp. Xxx) are rather distracting in general. I am not sure that that add clarity as intended.  
We modified the sentence in order to be clearer.

13-5 Isn't this horizontal direction?  
We modified the sentence in order to be clearer.

14-4 Not a clear statement!  
We replaced by: "We used two analytical methods based on ellipsoidal inclusions to estimate the physical properties of snow in the  $xy$  and  $z$  directions."

15-1 I found this development hard to follow. I feel that it would benefit from a significant coherent rewrite! As it is the presentation it too vague as a self contained presentation.  
We have rewritten our explanation of the SC estimate in order to be clearer.

15-4 Awkward sentence. Hard to get the meaning.  
The sentence, which was describing an other kind of self consistent method, has been suppressed for a sake of clarity.

18-3 Awkward sentence. Consider eliminating the parenthetical statements I feel they are unnecessary.

Modified

I think that some of the theoretical development is not clearly presented. These sections should be rewritten to improve the clarity. As they stand, I find them too vague to follow without going back to the primary reference. I'm not suggesting that they develop the concepts in detail, but they should be more clearly synopsized.

We have rewritten our explanation of the SC estimate in order to be clearer.