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Interactive comment on "A comprehensive interpretation of the NEEM basal ice build-up using a multi parametric approach" *by* T. Goossens et al.

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This manuscript presents a valuable contribution to the understanding of basal processes beneath Greenland, the development of the basal ice layer in the NEEM core, and the extent to which the palaeoclimatic ice core record can be extended down into the basal part of the ice core. Overall, I think this manuscript should be given strong consideration for full publication in The Cryosphere, although I make a number of suggestions below that I hope will improve some minor errors or issues with the manuscript in its current form.

In the full review and interactive discussion, the referees and other interested members

of the scientific community are asked to take into account all of the following aspects: 1.Does the paper address relevant scientific questions within the scope of TC? YES 2.Does the paper present novel concepts, ideas, tools, or data? YES 3.Are substantial conclusions reached? YES 4.Are the scientific methods and assumptions valid and clearly outlined? YES 5.Are the results sufficient to support the interpretations and conclusions? YES 6.Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? YES 7.Do the authors give proper credit to related work and clearly indicate their own new/original contribution? YES, although I suggest below some other papers that could be cited for completeness. 8.Does the title clearly reflect the contents of the paper? YES 9.Does the abstract provide a concise and complete summary? YES 10.Is the overall presentation well structured and clear? YES 11.Is the language fluent and precise? YES, in general, although I make several suggestions below. 12.Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? YES 13.Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? YES – suggestions below. 14.Are the number and quality of references appropriate? YES, although I make some further suggestions below. 15.Is the amount and quality of supplementary material appropriate? YES

SPECIFIC COMMENTS Abstract L1: I don't like this definition of basal ice. Firstly, Basal ice is not an expression – these are just 2 words in a sentence. 'Basal ice' could be an expression. Basal ice (italicized) could be and expression. Secondly, basal ice may or may not contain debris, let alone debris in layers, so the definition presented here is flawed. The inclusion of debris is not a defining characteristic of basal ice – basal ice occurs at or close to the ice-bed interface and is conditioned by processes acting at or near the glacier bed. Knight (1997) QSR gives a good definition. L2-3: The work undertaken in this study may represent a unique opportunity, but does the study of basal ice as a whole (in all cases, at all ice masses) represent a unique opportunity? I think you mean the former rather than the latter and should re-phrase accordingly. L6: You've missed out the particle size work in your list of tasks. L9: "were retrieved" –

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change to ‘was’ L10: The use of the term “specks” could be problematic. We now have a range of terms in basal ice research to define similar forms – clots, blebs, dispersed aggregates and particles, etc etc. One of the key problems in basal ice research is the proliferation of terms to define descriptively similar features or facies – see Hubbard et al. (2009) for a (relatively) recent discussion. Adding the term “specks” to an already crowded dictionary of terms could be regarded as unhelpful if you want to facilitate comparison of your work with that of others. Do you even need the term “specks”? Why not “Clear ice with particulate inclusions (CIPI – for example)? The specks and particulate inclusions essentially say the same thing anyway, so you are double-naming the facies. L20: The finding that CIS ice could extend the palaeoclimatic record in the ice core is a major finding, yet you don’t mention it in the conclusions!

P5557 L6-7: Again, this definition of basal ice is flawed – see above. Basal ice is ice conditioned by processes operating at or near to the bed. This interaction with the bed is commonly manifest as inclusion of debris, sometimes in layers, but basal ice facies vary greatly in character. P5557, L26: Change “to access” to ‘in accessing the bedrock’ P5557-8: You mention that several mechanisms for basal ice formation have been reviewed in Hubbard and Sharp (1989) and Knight (1997). However, since these papers were published, other mechanisms have been discovered to be important. For example, glaciohydraulic supercooling (Alley et al., 1998; Lawson et al., 1998 – in J Glac; Cook et al., 2006 – in Progress in Physical Geography) and porewater freeze-on beneath ice streams (Christoffersen and Tulaczyk, 2003 and Christoffersen et al., 2006 – J. Geophys. Res.). It might be appropriate, therefore, to cite the most up-to-date review of basal ice by Hubbard et al (2009) at this point. P5558, L13. Change “were” to ‘was’ P5558, L17. Change “referred” to ‘referred to’ P5558, L19. Change “timer” to ‘time’ P5558, L23. Spelling of ‘traditionally’ P5558, L24. I appreciate that the Tison et al. (2015) has set a precedent here in terms of the definition of basal ice, but I maintain that this definition is flawed. Basal ice does not always contain debris or any significant amount of debris. P5559, L29: change “event” to ‘events’ P5560, L8. Spelling of ‘Vienna’ P5560, L9. Spelling of ‘series’ P5560, L11. Spelling of ‘ensure’ P5561, L11.

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Here and throughout. Whether or not you take my advice about the naming of your ice facies (specks), it would be useful to either harmonise your classification with that of Hubbard et al (2009), or to provide in the text a statement about which of the ice types outlined in Hubbard et al.'s scheme your facies are equivalent to. You do this for DRL ice, but not for the other facies. P5562, L12: add 'particles' after "debris". P5562, L14: change "evidences" to 'evidence' P5566 L10-11: For your information, Cook et al (2010) in Boreas used freezing slopes of both cold and open systems to define an envelope of all possible isotope compositions involved in basal ice formation – might be a useful reference to cite here given that you have used a similar approach. This would also apply for P5567 L9-10. P5566 L17: change "biases" to 'bias' P5567 L15: change "exercice" to 'exercise' P5568 L17: change "combination" to 'combinations' P5569 L15: spelling of 'developed' P5570 L18-20: I couldn't make sense of this sentence. P5571 L10-14: I couldn't make sense of this sentence. P5573 L24: For your information, Waller et al. 2000 Quat Sci Rev and Cook et al. (2011) J. Glac, both discuss the potentially important, yet probably under-estimated, role of tectonic mixing in the generation and metamorphism of basal ice. P5574 L4: spelling of 'literature' P5574 L24: change 'moraine' to 'till' P5578 L15: change "litterature" to 'literature' Fig 1 caption: I suggest rewording this – "three contrasting visual ice types" doesn't really mean anything. I think you mean 'three visually contrasting ice types". Fig 3 caption. Change 'cumulated' to 'cumulative'. What is "volume density"? I'm sure this is something that the granulometer generates, but it seems an odd term. Fig 5. I appreciate the desire to present all information together in this diagram for direct comparison, but there are so many datapoints and lines that some information is obscured. Is it worth considering presenting multiple graphs? Perhaps with a combined graph too as you already have? Or even a "final" graph that just shows the lines of best fit after presenting individual graphs for each dataset.

Interactive comment on The Cryosphere Discuss., 9, 5555, 2015.