

Interactive comment on “Using a composite flow law to model deformation in the NEEM deep ice core, Greenland: Part 1 the role of grain size and grain size distribution on the deformation of Holocene and glacial ice” by Ernst-Jan N. Kuiper et al.

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The focus of this manuscript is to quantify the effects of grain size on flow of ice using a widely cited flow law with input from natural ice core data. The current study takes the additional step to examine the grain size distribution as a material state variable. On the basis of our models, we investigate and discuss various deformation mechanisms and estimate their relevance for bulk deformation, which is valid scientific practice.

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Our models suggest small grains can explain the often observed increase in strain rate in finer grained layers. This result is very important and we consider it worthy of publication.

Work on the relevance of micro-scale processes on ice deformation is essential to improve our understanding of ice sheet flow, which is now possible with the wealth of data we have gathered with our new evaluation methods. R#1 states flow of ice is strongly dependent on anisotropy and yet anisotropy is unable to explain certain phenomenological observations on flow variations, such as the lack of correlation between borehole logging results and anisotropy variations (pers. comm. Dahl-Jensen 31.1.2019; Weikusat et al. 2017, Cuffey et al. 2000). These and other aspects of the effect of anisotropy are discussed in Section 5.5. We thank R1 that this point is not clear enough and will add additional citations / wording to support our arguments,

There is still much we do not understand about the rate controlling mechanisms of flow in ice. Using models and grain size data from naturally deformed ice is a valid approach to examine these mechanisms.

Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2018-274>, 2019.

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