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Interactive comment on “Brief communication: Sampling c-axes distributions from the eigenvalues of ice fabric orientation tensors” *by* Martin Rongen

Anonymous Referee #1

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This brief communication presents a sampling method to build discrete c-axis distribution for given eigenvalues of the second-order orientation tensor using a superposition of girdle and single maximum fabric given as a Watson distribution.

Even if the proposed method is certainly interesting, the glaciology context is clearly missing. A number of previous works have already been done on that subject and are not mentioned in this paper. For example:
- in Gagliardini et al. (2009), a comprehensive list of the PDFs that have been proposed in the literature to describe polycrystalline fabric is given and they are all

compared in their capability of representing observed fabrics.
- the form proposed in this paper was already proposed as a good possible representation of ice fabric by Lliboutry in 1993.
- Gillet-Chaulet et al. (2005), with the same objective as in the current paper, have presented a method to construct a discrete fabric for given eigenvalues of the second orientation tensor assuming a parameterised PDF derived from an analytical solution and capable to describe directly orthotropic fabrics (without the need of superposition of two PDFs restricted to transversally isotropic fabrics as in the proposed approach).
In other words, there are clearly missing references to give an appropriate context of what have already been done on that subject in glaciology (and certainly other than the three listed here).

Over the three figures, Fig. 1 is from Woodcock (1977) and Fig. 2 is from Duncan Campbell (from his github). Did the author get the authorization to replicate these figures in his paper?

Regarding the result of the method, I don’t really understand why the uniform fabric presented in Fig. 3a has not $S_1 = S_2 = S_3 = 1/3$ exactly. This should be possible? It is surprising that it is for the simplest fabric (uniform) that there is the largest differences between the input and output eigenvalues. As discussed at the end of the paper, it seems that the assumption that a natural fabric can be described by the superposition of a purely girdle and a purely unimodal Watson distribution is a bit strong and doesn’t work especially for not textured fabric (i.e. fabric close to a uniform distribution). I would have like to see an inverse approach showing how a real fabric can be described using the superposition of two transversally isotropic PDFs, as done in Gagliardini et al. (2009).

Minor remarks:

- page 1, line 8: polycrystalline ice will most
- page 2, line 11: I don't understand the "strict" ordering (eigenvalues can be all equal for a uniform distribution). It should write $S_1 \geq S_2 \geq S3$.
- page 2, line 24: the citation should be Voigt (2017). Donald is the first name, not the family name. Same at other places and in the references section.

Gagliardini O., F. Gillet-Chaulet and M. Montagnat, 2009. A Review of Anisotropic Polar Ice Models: from Crystal to Ice-Sheet Flow Models. In "Physics of Ice Core Records II", Supplement Issue of Low Temperature Science, Vol. 68, December 2009.

Gillet-Chaulet F., O. Gagliardini , J. Meyssonnier, M. Montagnat and O. Castelnau, 2005. A user-friendly anisotropic flow law for ice-sheet modelling. J. of Glaciol., 51(172), p. 3-14.

L. Lliboutry. Anisotropic, transversely isotropic non linear viscosity of rock ice and rheological pa- rameters inferred by homogenization. Int. J. Plast., 9:619–632, 1993.

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