Dear Olivier Gagliardini,

Thank you for these valuable comments.
Please refer to our point-to-point changes below.

Kind regards,

Sebastian Hellmann
on behalf of the co-authors

*- line 17: valuable insights on the **current** stress and strain distribution... I think it is more strain-rate than strain, as strain cumulates all strain-rate since snow deposit (which cannot be reconstructed from the current ice fabric as many different strain-rate history cumulating the same strain might give the same fabric in temperate ice). There are a number of places elsewhere in the manuscript where strain is used in place of strain-rate. Check this.*

Changed.

- line 27: strains -> strain-rates

Changed.

- line 63: with studies from the last century -> with previous studies

Changed.

- Figure 3: Not so easy to visualise the compressive state with this plot. Why not plotting a map with the longitudinal strain-rate computed from the velocity field? (and also other components of the surface strain-rate using 3 subplots: Exx, Eyy and Exy). Explanation from lines 91-93 would be simplified.

We combined this figure with Fig. 2 for better understanding and also changed the x-axis from “azimuth realtive to the ice core borehole” to “borehole index”. Then, in combination with Fig. 2a and the ice flow therein it should be clear that the boreholes in the south are flowing slower than the ones in the north. We also adjusted the respective text.
In addition, we also include the requested strain rate plots and refer to them in an additional sentence.

- line 105: was chosen with n=3 -> was chosen to n=3 (?)

Changed to “was set to n=3”

- line 108: what is the value of m?

Added to the text: [...] while m = 3 and c are constant parameters. [...]

- line 113: bedrock velocity -> sliding velocity

Changed.

- lines 129-130: you should mention first that fabric will induce an anisotropic viscous response of ice, especially because the viscous response is more anisotrope than the elastic one mentioned here (and is of better interest for glacier flow).

We added this point: This results in an anisotropic viscous response of the glacier ice (Schulson and Duval, 2009, Chapt. 6).

- line 160: I don't understand the z = y' and y = −z' notations. Is that true for all three types of thin sections? To help the reader, the two reference frames (x,y,z) and (x',y',z') should be plotted in Fig. 4.

We adjusted our explanations and added the local coordinate systems (x',y',z') for the vertical sections and the reference frame (x,y,z). The horizontal section is already measured in the ice core reference frame (upper right corner of Fig. 4) which we now explicitly state in an additional sentence.

- Figure 5: You should indicate the limit of the sample for c-axis orientation measurements. There are a number of very small grains at the limit of the sample that I guess are not measured (seems to be a result of the drilling technics which melt the ice)? Why not plotting the midpoint on this figure?

We added a semi-transparent pale layer covering the area that we excluded from the analysis. The small grains around the ice core sample you mention arose from the liquid water that "glues" the sample to the sample holder and freezes immediately in the cold laboratories. This has nothing to do with the drilling and is a common feature in all FA images.
We added the midpoints to the stereoplots (as in Fig 7).
The minimum amount of pixels that is required to consider an area of similar pixels as "ice grain" is 500 pixels and already given in the text.

- lines 218-219: No the Cauchy stress is not the deviatoric stress! And p is the isotropic pressure. So it should write: "model to derive the deviatoric stress tensor, which is defined as the Cauchy stress tensor minus the isotropic pressure, i.e.:"

We removed this half sentence as it is explained correctly in the following sentence.

- Table 2 would be more useful on the form of a graphic to visualize the evolution with depth of the stress components? Indicate also somewhere the sign convention that negative is compressive.

We add a graph that shows the changes for each component with depth. Table 2 is obsolet now and therefore we removed it from the manuscript. However, we have to mention here that both reviewers asked for the actual numbers.

- Caption of Table 3: I don't understand why you are using the borehole measurements to derive the strain rates? For a given depth, the ratio between a stress component and the corresponding strain-rate component should be constant (which seems the case). More explanations are needed on how the strain-rates are calculated.

This "derived from borehole measurements" was a "leftover" from the previous version. We calculated the strain rates from the model and in addition from borehole measurements. The reviewers did not see benefits from the strain rates from borehole measurements. Therefore, we removed the values, but we have overseen this in the caption.

- line 226: Not sure to understand what you mean by the direction of stress and strain-rate are parallel. More than parallel, using an isotropic law, you assume the collinearity of the two tensors (each components is proportional to the other S_ij = A D_ij with A a scalar)
- lines 228-229: The orientation dependent response of an anisotropic ice is certainly the main deviation, the alignement of the two tensors comes after. You can get up to an enhancement factor of 10 for anisotropic ice.

For both comments, we changed the respective paragraph:
Since the model does not consider anisotropy, orientation dependent response of the anisotropic ice is not considered. For typical fabrics (e.g. single maximum, girdle fabric), enhancement factors could be introduced (e.g. Thorsteinsson, 2001; Pettit et al., 2007) to overcome this issue. Beyond, anisotropic flow laws (e.g. Gillet-Chaulet et al., 2005) can be employed to consider more complex fabrics such as the multi-maximum pattern. Furthermore, in isotropic models, stress and strain rate are connected with a scalar value and the principal axes of stress and strain rate tensors are parallel. These are a crucial limitation to be considered in the following interpretation. Especially for shear stress, the model-derived and the actual strain rate directions may differ significantly. In addition, the quantitative numbers deviate from isotropic ice as the aforementioned basal sliding affects the strain rates that an ice grain experiences. However, we regard the modelling output as auxiliary values for our interpretation.

- line 231: I don't understand the "is too complex for the multi-maxima patterns". There are a number of micro-macro models that could (and have already) computed the anisotropic response of an ice sample for a given fabric. One could use for example the simple Static model assuming homogeneous stress in the crystals to evaluate the polycrystal response for such multi-maxima fabrics.

Thank you very much for this remark. We rephrased this sentence: Beyond, anisotropic flow laws (e.g. Gillet-Chaulet et al. 2005) can be employed to consider more complex fabrics such as the multi-maximum pattern.

- line 234: eigenvector of which tensor?

Changed: eigenvectors of the stress tensors

- line 244: Figs. 3 and 7

“s” added and changed 3 -> 5

- line 245: My understanding of recrystallisation fabrics is that they adapt almost "instantaneously" to the current state of stress. Not sure you need to mention the last four decades?

In the first version we wrote “recently”. However, this was said to be imprecise writing. Therefore we added a time frame. We remove the “in the last four decades” but keep the residual sentence as is.

- line 271: strain or strain-rate?

Changed: strain rate

- line 272: I don't see easily why the presence of simple shear would induce that the principal directions are not anymore aligned, even for an anisotropic material (e.g. orthotropic)? May be add a reference here.

In presence of simple shear stress there is a 45° "misorientation" between strain rate and stress. We added a reference that describes this.

- *lines 277, 280, 285 strain or strain-rate?*

Strain rate is correct in the first two and also the better term in the last case.

- *line 280: Why for the depth 79m, the strain (rate?) is used instead of the stress? And how do you get the principal direction?*

This is again the non-coaxial theorem for cases in which simple shear dominates. In such cases, the principal stress and principal strain rate axes are not aligned but tited from each other by 45°.

- *line 287: open bracket not closed.*

Added a ")" at the end of the sentence.

- *line 321: what do you mean by high temperatures? A temperate glacier is at the highest possible temperature ice can be?*

Changed: "these temperate conditions in Rhonegletscher are a prerequisite"

- lines 326-332: why not discussing this above when these processes are introduced.

We also followed your recommendation here. Please see the file for changes as several sentences were moved into the section 6.3.