Many thanks for big efforts by both of reviewers and editors for the manuscript tc-2021-336.

We have revised the manuscript according to the comments and suggestions from reviewers and editor. The grammar in changes and additions were checked by a native speaker of English.

The modifications (highlighted in yellow in the revised manuscript) are as follows:

Added sentences, references, and figure

(L51) Reference: e.g., Alley et al., 1996; Gow et al., 1997; Durand et al., 2006 (RC1)

(L82) The resulting data were compared with the profiles of various physicochemical parameters, such as major ions, dust particles, salt inclusions and grain sizes, obtained from analyses of the DF ice core. The goal was to better understand the factors influencing COF development (RC1)

(Table 1 caption) Although the precise thicknesses of thin sections are not provided in Wang et al. (2003) or Durand et al. (2007, 2009) (missing data are indicated by the # symbol in this table), it can be assumed that the thicknesses of sections prepared for optically-based COF measurements were approximately 0.5 mm or less. (RC1)

(Figure 2) Figure 2. Diagrams of (a) core cutting geometry and (b) experimental setup (viewed from the front) (RC2)

(L112) A diagram of the core cutting geometry is shown in Fig. 2a. (RC2)

(L116) Note that interpretation of the COF data obtained from dielectric measurements is challenging below 2400 m due to the presence of inclined layers and extremely coarse crystal grains. At these depths, the layered structures begin to incline relative to the horizontal plane, with inclinations of less than 5° above 2400 m but much larger values of 20° and 50° at 2800 and 3000 m, respectively (Dome Fuji Ice Core Project Members, 2017). Additionally, visual inspection showed extremely large coarse grains (with grain sizes > 50 cm) in samples from the deepest part of the dome. The effects of these factors should be confirmed by future research but, for the present, we restricted our analyses to a depth of 2400 m for these reasons. (RC1)

(L131) A diagram of the experimental setup is provided in Fig. 2b. (RC2)

(L168) The detrended $\Delta\varepsilon$ data represent the relative degree of *c*-axis clustering and the extent of deformation relative to those in the surrounding depth. These detrended values are more useful than the original values as a means of assessing fluctuations in the COF and for comparison with other physicochemical properties. (RC1 and RC2)

(L203) Reference: see the appendix in Saruya et al., 2022 (RC1)

(L220) Thin-section measurements can provide information regarding localized distributions of *c*-axis orientations for each grain within thin-sections, while thick-section measurements indicate the COF characteristics on a bulk scale. (RC2)

(L231) Saruya et al. (2022) reported the relationship $\varepsilon_x = \varepsilon_\perp + \Delta\varepsilon_s\, a_1^{(2)}$, where ε_x is the relative permittivity along the principal x axis and $\varepsilon_\perp$ is the permittivity perpendicular to the *c*-axis. Thus, if ε_x and ε_y (the relative permittivity along the principal y axis) are approximately equal, these permittivity components have variable range as $\Delta\varepsilon_s\, a_1^{(2)}$. The eigenvalue $a_1^{(2)}$ changes from 0 to 1 while $\Delta\varepsilon_s = 0.0334$. A value for $\varepsilon_\perp$ of 3.1367 is also provided in the appendix to Saruya et al. (2022). Using this relationship, we can compare eigenvalues and permittivities. (RC1)

(L292) Saruya et al. (2022) reported that such errors were minimized by solving equations for multiple resonance frequencies simultaneously to find a unique solution for ε. They determined the total error in ε to be – 0.01 ± 0.01, and this systematic error was primarily attributed to the limited widths of the ice core samples. (RC2)

(L313) Complex permittivity data obtained for ice based on analyses using megahertz frequencies were reviewed by Fujita et al. (2000). The real part of the complex permittivity of the ice in ice sheets is a function of the COF as well as the density, the concentration of soluble impurities (primarily acidic impurities) and the temperature. In contrast, both the hydrostatic pressure and the shape of air bubbles have relatively minor effects. In addition, the effect of plastic deformation can be significant and needs to be investigated further. What we are interested in here is whether or not some factors other than COF can modify the anisotropic values of permittivity; in the case of ice containing bubbles, the density, soluble impurity concentration and temperature do not modify the dielectric anisotropy (Fujita et al., 2000). Thus, COF is the only factor responsible for anisotropic permittivity in the polycrystalline ice in the ice sheet. In addition, to date, grain boundaries, dust inclusions, clathrate hydrate inclusions or salt inclusions in ice have not been shown to produce detectable changes in permittivity. (RC2)

(L421) HCl can dissolve in ice while dissociating to release Cl^- ions, while NaCl will exist as solid particles. Therefore, the concentration of HCl is considered to be directly correlated with the concentration of discharged Cl^- ions. (RC1)

(L482) At very shallow depths, at which the COF is almost random, the *c*-axes start to rotate toward the compressional axis as deformation progresses. In this early stage, the rotation of these *c*-axes in this manner increases the density of slip planes close to the plane of maximum shear stress (45° from the compressional axis). This deformation enhancement is temporarily higher than that of the initial random fabric, such that the initial deformation softens the ice in a positive feedback loop. In contrast, as the fabric continues to develop, the ice becomes harder as these *c*-axes rotate closer to the compressional axis. In the case of the majority of the crystal grains, the slip planes will tend to rotate away from the plane of maximum shear stress and so the ice will become progressively harder in a negative feedback loop. (RC1)

(L512) Because Cl^- ions have the greatest effect on the densification of firn (Fujita et al., 2016), we suggest that these ions are among major factors determining the depth of the transition from firn to bubble-containing ice, known as the lock-in depth (LID). It is also likely that the $\Delta\varepsilon$ values along deep ice cores are valuable indicators that can be used to determine the timescale of the LID in detail. In addition, these $\Delta\varepsilon$ values will be directly correlated with the vertical thinning of each layer and so can be extremely useful as a means of refining ice core dating models and providing constraints on strain values. Because both the LID and vertical thinning are related to the strain rate enhancement caused by the COF, the presence of Cl^- ions and the temperature of the ice, it is apparent that the variations in the LID over time and the cumulative vertical thinning in each layer should be closely related. This possibility should be examined in future studies.

(L553) In fact, layering disturbances and folding at the lower regions of ice cores have been previously observed on several occasions (e.g., Svensson et al., 2005; Faria et al., 2010; Jansen et al., 2016). As an example, Jansen et al. (2016) investigated small-scale disturbances at the bottom part of the NEEM ice core based on numerical modelling and concluded that the folding structures were initiated by the formation of bands in which the lattice was tilted relative to the bulk COF. This conclusion is in agreement with a prior report by Azuma and Goto-Azuma (1996). Although visual inspections have not identified layering disturbances in the EDC ice core, Durand et al. (2009) found significant fluctuations in eigenvalues. This same group established that there were no clear correlations between the fabric fluctuations and climate or chemical composition. Below a depth of 2846 m, very small grains (less than 1 mm in size) appeared between larger grains, indicating the onset of crystal nucleation. Although signs of migration recrystallization, such as interlocking grain boundaries, were not observed, their findings suggest the possibility of migration recrystallization at sufficiently high temperatures. Thus, further more detailed investigations are required for a better understanding of the COF development and deformation regime in the deeper parts of the core. (RC1)

Removed sentences

(L209 in the original manuscript) This result implies that the statistical validity of the thin-section-based method is inferior to that of the thick-section-based method. (RC2)

(L540 in the original manuscript) Samples taken at a distance from the dome summit (or samples acquired after the dome summit migrates) or at greater depths will likely reveal stresses with various configurations resulting from ice flow, undulating bedrock or inhomogeneous basal melt. In such cases, the vertical single-pole COF with layered cluster strength will be sensitive to shear stresses. Specifically, layers with more or less COF clustering will behave differently. Under such circumstances, the primary factors (Cl^- ions and dust particles) will have an effect, but variations in COF will also play an important role in determining further layered deformation and flow. Therefore, (RC1)

(L552 in the original manuscript) Finally, the present work demonstrated that dielectric permittivity tensor measurements are a powerful means of evaluating the COF structure of an ice sheet. (RC1)

Modification

(Figure 3) We changed plot colors. (RC1)

(Conclusion) We simplified “Conclusion” section and used bullet. (RC1)