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Interactive comment on "Elastic-viscoplastic characterization of S2 columnar freshwater ice" *by* Iman E. Gharamti et al.

Anonymous Referee #1

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This manuscript describes the results of experiments on the deformation of freshwater ice near its melting point. Specifically, it describes the rate of opening of notches that were cut into large blocks (∼0.4 m x 3 m x 6 m) of columnar-grained ice that possessed the S2 growth texture. The blocks were floating in an ice tank and the sides of the notch were pried apart at different rates of loading until the ice split. Prior to fracture, also described, load was applied either cyclically or constantly for a period of time. The principal finding and conclusion is that under the conditions of the experiment, "creep and cyclic sequences had no clear effect on the apparent fracture toughness, the failure load, and the crack opening displacements" (line 320-321). Although a negative conclusion, that result is worth publication in The Cryosphere.

The authors go further, however, weakening/endangering the manuscript. They ana-

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Discussion paper

lyze their data in terms of a constitutive model that was developed by Schapery (1969, 1997) for uniaxial loading (noted in lines 171-173). But in the experiments at hand, deformation occurred under a multiaxial stress state. Given that the model and the data relate to different states of stress and given that values of the many (eight) unknown parameters in the model were derived by fitting the data and not from independent measurements, it is difficult to accept the statement (lines 303-305) that the analysis " provides a firm support of the ability of Schapery's constitutive model to describe the time-dependent response of columnar freshwater S2 ice up to crack growth initiation." It is even more difficult to accept the claim (lines 242-243) that under the conditions of these experiments "there is no delayed elastic recovery".

The title presents a problem: it is misleading. This is not the kind of experiment that allows a characterization of elastic-viscoelastic deformation of ice. Rather, as already noted, it allows a conclusion to be made on fracture toughness and its insensitivity to pre-strain. The title needs to be changed to reflect that finding.

The other problem is that the manuscript contains a contradiction. The claim that the experiments were performed on ice at -2 o C contradicts the temperature profile shown in Fig. 3a. There, where temperature is plotted versus depth (from $\sim$0 to 35 cm) in the ice, temperature ranges from -0.3 o C near the top to $\sim$ 0 o C near the bottom.

Finally, it would be helpful to know in which journal the repeated reference to Gharamti et al. is "in press".

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