Reviewer 3 (Wilfried Haeberli): Author response

Thank you for the constructive comments on our manuscript.

First, we agree that additional quantitative methods exist to assess glacial lake evolution and GLOF hazard. However, given the limited data availability, uncertainty of many processes, and complexity of the lake bathymetry, glacial bed, and geological setting at Fjallsjökull, our conclusion is that retreat rates resulting from numerical ice flow and calving models with uncertain boundary conditions will not add significantly to the results or change the main conclusions of this study. Thus, we prefer to take the simple approach presented here and to focus on the impact and broad time scale rather than a detailed, but widely uncertain, timing of events. The results of this study also contribute newly collected field data of proglacial lake bathymetry, which provide the foundation for several additional studies along the lines suggested by the reviewer (i.e. calving; displacement wave propagation), but which are beyond the scope of our project. Though we mention some of these suggested methods and references in the manuscript, we will add more detail about the required parameters and include more citations of studies applying these approaches. We address the separate points of the review in detail below.

- **Lake–glacier interactions/calving fronts:**

Interactions between the glacial lake and terminus will significantly influence future glacier retreat rate in ways that we discuss in Section 5.2 (lines 323-338). While equations to quantify this effect exist, we decided not to apply them because some crucial input parameters such as future surface mass balance and ice thickness are unknown. However, we will make these changes in the manuscript:

1) Explicitly state which parameters are needed to make these calculations (i.e. ice thickness and surface mass balance), expanding the discussion currently in lines 323-339.
2) Add the relevant citations suggested by the reviewer to make this discussion more detailed and less general.
3) Add two additional scenarios to the study for estimated future glacier retreat rates to assess result sensitivity: 1) A rate based on projected climate change in Iceland from Noel et al. (2022), where glacier retreat rate slows until ~2040 and then increases; and 2) a faster retreat rate (doubling compared to the 2000-2021 rate) after the terminus enters the northern (deeper) overdeepening in the lake. Though these rates will still be linear, taken together, they will represent three relative "paces" to reflect the influence of overdeepening depth and future climate warming variability.

- **Rock avalanche propagation:**

Geological and structural mapping is necessary to delineate potential slope failure planes and thus calculate rock avalanche volumes and propagation dynamics, as we explain in lines 341-343. However, geological mapping in necessary detail has not been done for the Fjallsjökull area; regional geology is too complex to interpret based solely on remote sensing data such as drone or satellite imagery or InSAR; and this mapping is a significant project in itself and beyond the scope of this study.

However, we will:

1) Expand our discussion of rock avalanche propagation after line 343 to list methods (such as InSAR) that could be used to geologically map this area and specify which information they could yield (i.e. likely failure planes; landslide volume; areas of ongoing deformation; existing fractures).

2) Add some examples of studies applying these approaches, including those suggested by the reviewer.

- **Displacement wave propagation and GLOF scenarios:**

Without comprehensive geological mapping to estimate realistic landslide volumes and travel dynamics into the glacial lake, we cannot accurately model displacement wave propagation or downstream flood behavior. Though we describe the information required to do this in lines 416-420 and 455-461, we will expand this discussion in Section 5.4 to explicitly state which parameters are known (i.e. lake bathymetry) and unknown (i.e. landslide volume and velocity). We will also provide some examples of studies that have used these approaches, notably citing relevant references suggested by the reviewer.

Second, our study is a preliminary assessment, but we argue that this does not reduce its scientific contribution. This is the first study that investigates mass movement-triggered GLOF hazard in Iceland (with the exception of a 1967 paper that described the geomorphologic impacts of the only documented event in Iceland). The study of Fjallsjökull's environment and GLOF risk is designed to be a pioneering example of assessing this emerging hazard at glacial lakes in Iceland, as well as other lakes worldwide where growth in potential GLOF risk is outpacing the speed of research. We will emphasize this broader application in the Introduction, Conclusion, and end of Section 5.4 (lines 454-466), and also list examples with relevant citations of additional sites that should be prioritized for future study due to increasing tourism and mass movement-triggered GLOF potential in Iceland (i.e. Svínafellsjökull and Sólheimajökull) and other global proglacial areas (i.e. Alaska). Though we initially started to assess this hazard using GAPHAZ (2017) criteria, we did not have enough input data at Fjallsjökull to complete a full analysis; thus, we selected the parameters that we could quantify for our study. However, we will add a brief discussion of GAPHAZ (2017) into the manuscript as a risk assessment method, including citations of studies that have applied it (i.e. Sattar et al. (2023)).

In addition, one of our study's central contributions is high-resolution field measurements of lake bathymetry, whereas many similar studies (such as Sattar et al. (2023) and Gantayat et al. (2024b)) estimate glacial lake volume and overdeepenings from models. We believe that this field-derived dataset is a significant contribution that can be used to test or calibrate models, as well as provide accurate input parameters for additional methods that require bathymetric data.

Finally, to address the comment about the cautions on estimating lake volumes from empirical equations, we agree with the reviewer and want to emphasize that the lake volume presented in the manuscript is calculated from the new field-measured bathymetry—not from empirical equations. We only mention the equations and compare them to our field-derived results to emphasize the importance of field measurements and illustrate that equations may not accurately predict lake volumes. However, we will add the recommended relevant citations of Muñoz et al. (2020) and Gantayat et al. (2024a).

Technical comments:

We accept these suggestions and will update accordingly. As for the use of "climate warming," we will replace it with one of the suggested terms ("ongoing climate change," "atmospheric temperature rise," or "global warming").