

## ***Interactive comment on “Ice flow models and glacial erosion over multiple glacial–interglacial cycles” by R. M. Headley and T. A. Ehlers***

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Referee 1 has provided helpful criticisms to strengthen the manuscript. Here, we address some of the specific points. Please see our general response and our response to referee 2 for more details regarding our revised manuscript.

One of the referee's major points is that warmer/wetter runs leading to more erosion is not a surprising result. We agree with this assessment in general, but in the manuscript, we have tried to emphasize that the scale of the differences between the different models can become more significant depending upon the climate. In order to show this, we needed to also present the simpler effects of climate alone for the models.

The referee raises a good point that we could add additional discussion on the phe-

C277

nomenological processes that cause the cumulative variance between the models. This can mostly be attributed to the sliding velocity, which is a strong function of the basal shear stress. In the figures, particularly Figures 5 and 6, we focus on the erosion rate because it directly scales with the sliding velocity and closely mimics the pattern of basal shear stress. In the revised manuscript, we have added further discussion on these processes in an augmented discussion section. This is used to motivate expansion of Section 4.3 where we qualitatively discuss different sliding, erosion, and hydrology, and their associated feedbacks with glacial flow (see related comments to referee 2 also).

### Specific comments

With regard to the climate simulations, the model simulations are run from 0 years forward. The referee is correct that we have used rapid cooling and long, slow warming, which is the opposite of the natural, Pleistocene glacial cycle. These details have now been discussed and corrected in the revised manuscript.

Figure 1: Figures 9 and 10 have the bedrock and bed + sediment layers. The initial profile, the same for all runs, can be added to this plot. We did not feel that ice thickness added much information to these plots. However, a snapshot of the ice thickness (and other topographic properties) along the profiles as sub-figures has been incorporated into Figure 1.

The glacial pulses are considerably large compared to single glaciations, particularly the sinusoidal climate forcing. While we are not aiming to explore a particular natural setting, we have further emphasized the long-term evolution effects versus the single-glaciation, shorter-term effects that have also been studied in previous work.

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C278