The main process that we are attempting to model is the glacial cycle. Due to variations in the Earth’s orbital parameters, bedrock level, and topography, these cycles can change. There are 3 main equations that can be used to represent the model. Other processes can also affect the model, such as ice sheet runoff and ice calving.

[eq 1]

Equation 1 is a diffusion equation where h represents the thickness of the ice, h’ represents the bedrock surface elevation, x represents the vertical distance to the south, and t is time. A, alpha, and beta are constants. This equation also takes in another equation, represented by G, which is a function of h, h’, x, and the orbital parameter E. This is assumed to have a constant slope wrt latitude in this model.

[eq 2]

In this equation, a and b are also constants. The orbital parameter, E, includes a reference equilibrium value, E0, and is a function of deltaQ, which is stated to be the difference in the summer half-year insolation at 55N. k is also a set parameter.

[eq 3]

The third equation represents a thin-channel model for the aforementioned processes. In this case, r is the ratio of ice density to rock density, and h’0(x) is the dominating surface topography by a function of latitude. Nu is a separate expression and is a function of rock density, the thickness of the channel and its dynamic viscosity, and gravity.

There are some assumptions made in the original model as well. East-west flow is neglected, so we are assuming that only north-south flow matters. Minor elastic deformation dynamics are also neglected for the purposes of this model.

In our model, we assume G is constant, as our time step is small. We are also neglecting the aforementioned processes, such as ice calving, that could theoretically affect the model in the long-term.

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In our model, we ran two main simulations with varying initial conditions. Specifically, we tested the effect that the initial ice sheet height would have on the model, using values of 0 meters and 500 meters to visualize this.

Unfortunately, we were unable to get the model to run over the entire intended time period. This means we were not able to see all of the distinct oscillations in ice sheet cross-sectional area that the model in the original paper showed. However, for the length of the time periods we were able to run the model in, we were able to see that the cross-sectional area of the ice sheet reaches a steady state over time.

Between our simulations, we achieved similar results, but were able to demonstrate an effect from the differences in the initial conditions we set. Both simulations eventually reached a steady state in the ice sheet cross-sectional area, but the simulation where the initial height was set to 500 meters had a greater height as it’s steady state. [glacier area area results here, I wasn’t sure if we actually ran the final model where h\_0 was 500m]

There are several ways our model could be improved. Unsurprisingly, if we were able to get the model to successfully run over the entire intended time period, the results would be a lot better and more conclusive. We also opted to not utilize the Newton-Raphson scheme for our model. If we were to utilize this method in our model, the results might have also been a bit more conclusive since the model in the original paper made use of this method.