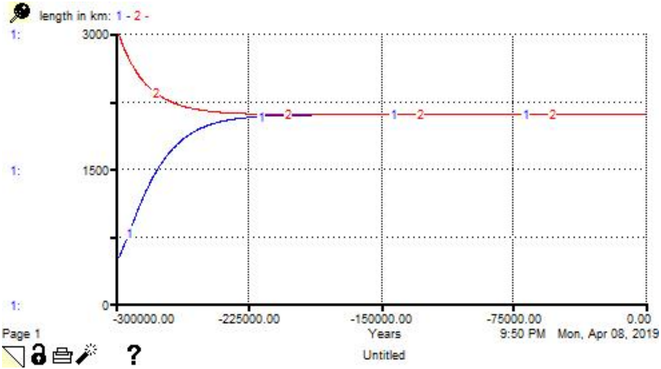
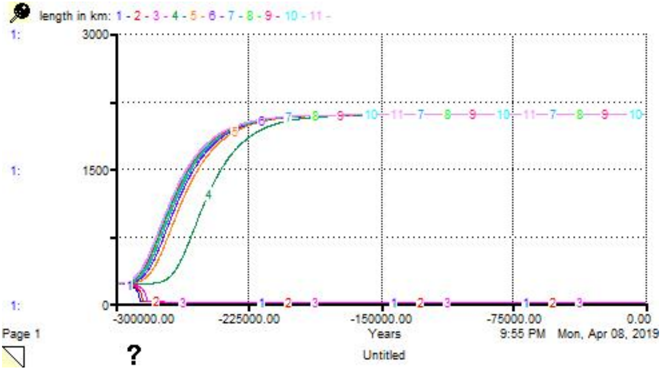
Ice sheets

1. Steady state/response time



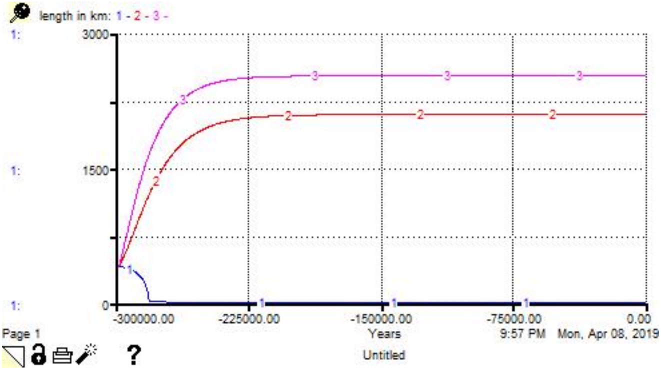
- Evolves to a steady-state length of 2100 km.
- Response time is on the order of 50 ka.

2. Crossing threshold to rapid melting



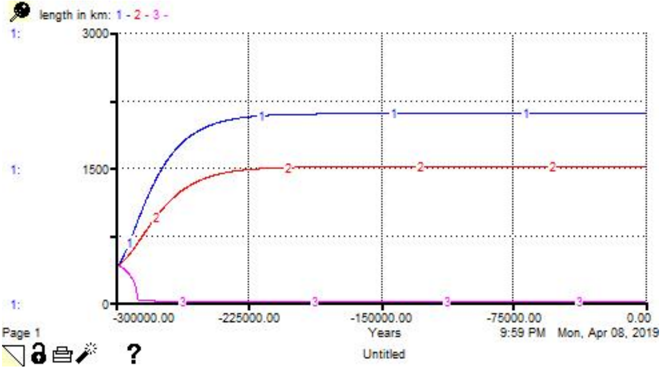
- Threshold behavior at about 203 km.
- Positive feedbacks dominate at lengths less than 203 km.

3. Changing the grounding line/climate



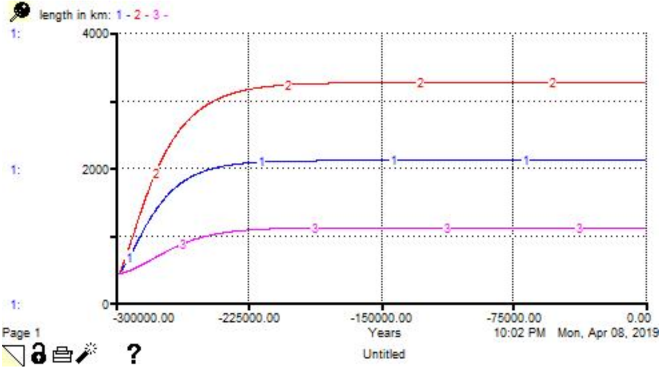
- Warming the climate changes the "ice sheet-no ice sheet" threshold.
- Large ice sheet not possible in warmer climate.

4. Changing the ice strength



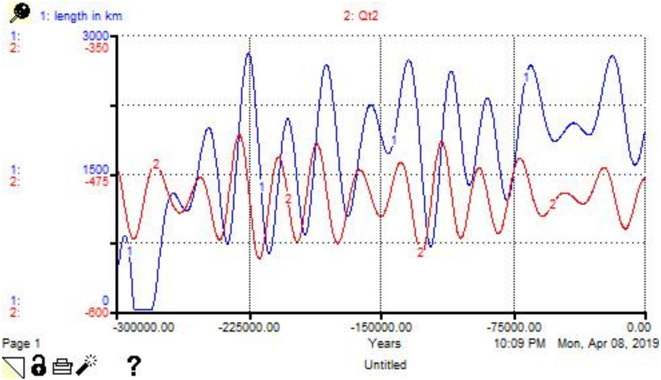
- Reduced ice strength leads to thinner ice and more rapid melting → ice sheet disappears

5. Changing ratio of accumulation and ablation rates



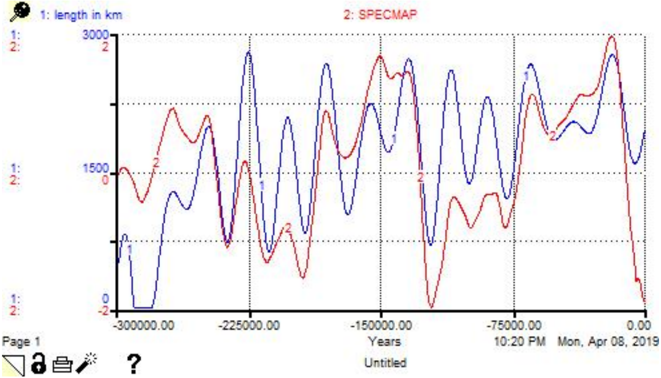
- Ice sheet size increases if the accumulation-to-ablation ratio is increased.

6. Orbital forcing



- Note that I plotted $-Q_t$ to make it more clear that cold periods coincide with large ice sheets.
- Lag time of a few thousand years.
- Looks like we should be entering a cool period.

6. Orbital forcing



- Pretty good agreement with SPECMAP (marine isotope record)

7. Feedback loops

- *Elevation-climate feedback*: positive feedback loop, in which thickening pushes the ice sheet into a colder climate, which enables more thickening, and vice-versa.
- *Length-climate feedback*: negative feedback loop, in which increases in length increase the size of the ablation area, leading to increased melting.