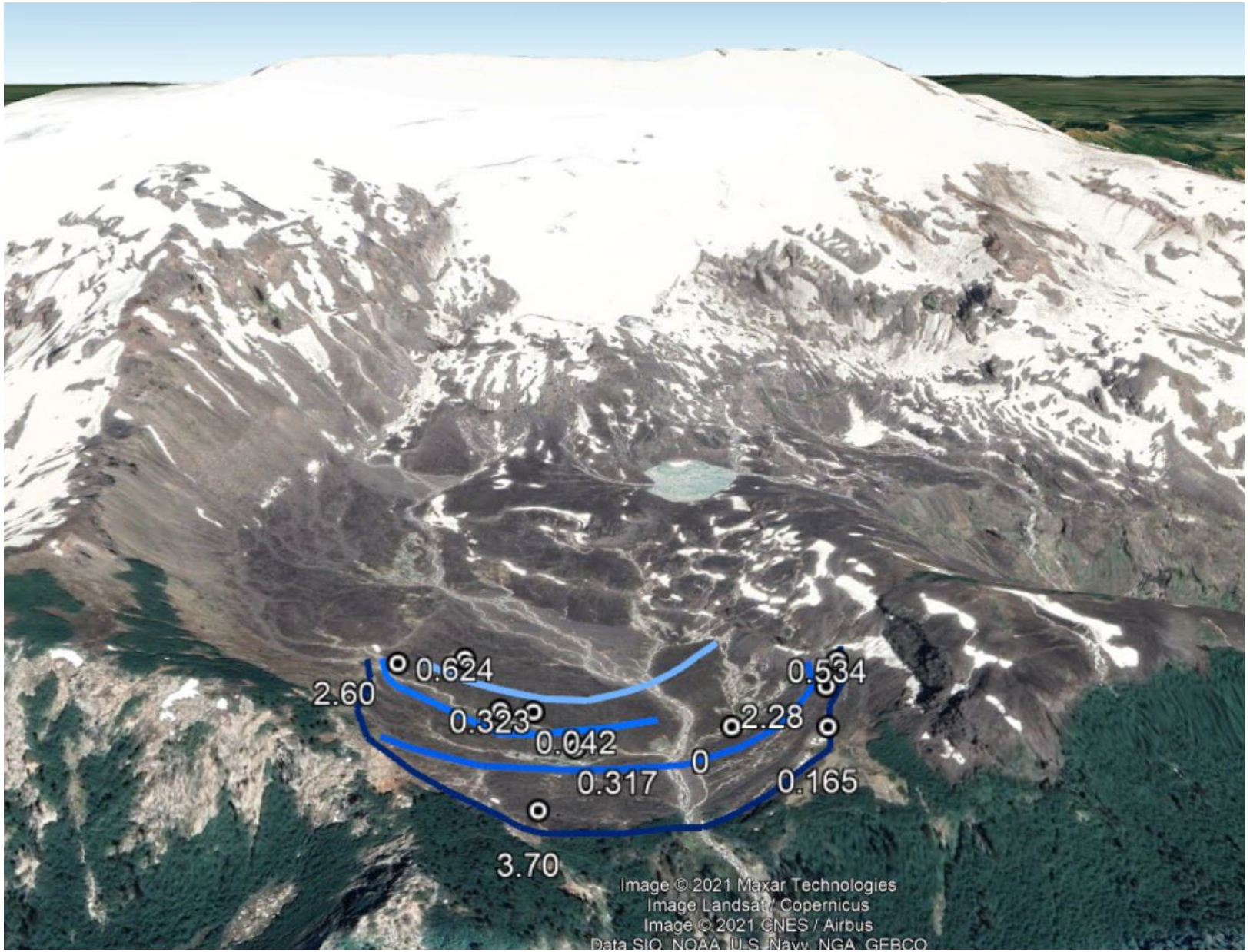
Attempting to Reconstruct LIA conditions and Ice Extent at Mt. Sierra Nevada, Chile

Mt. Sierra Nevada, Chile
38°34'48.39"S, 71°34'40.57"W

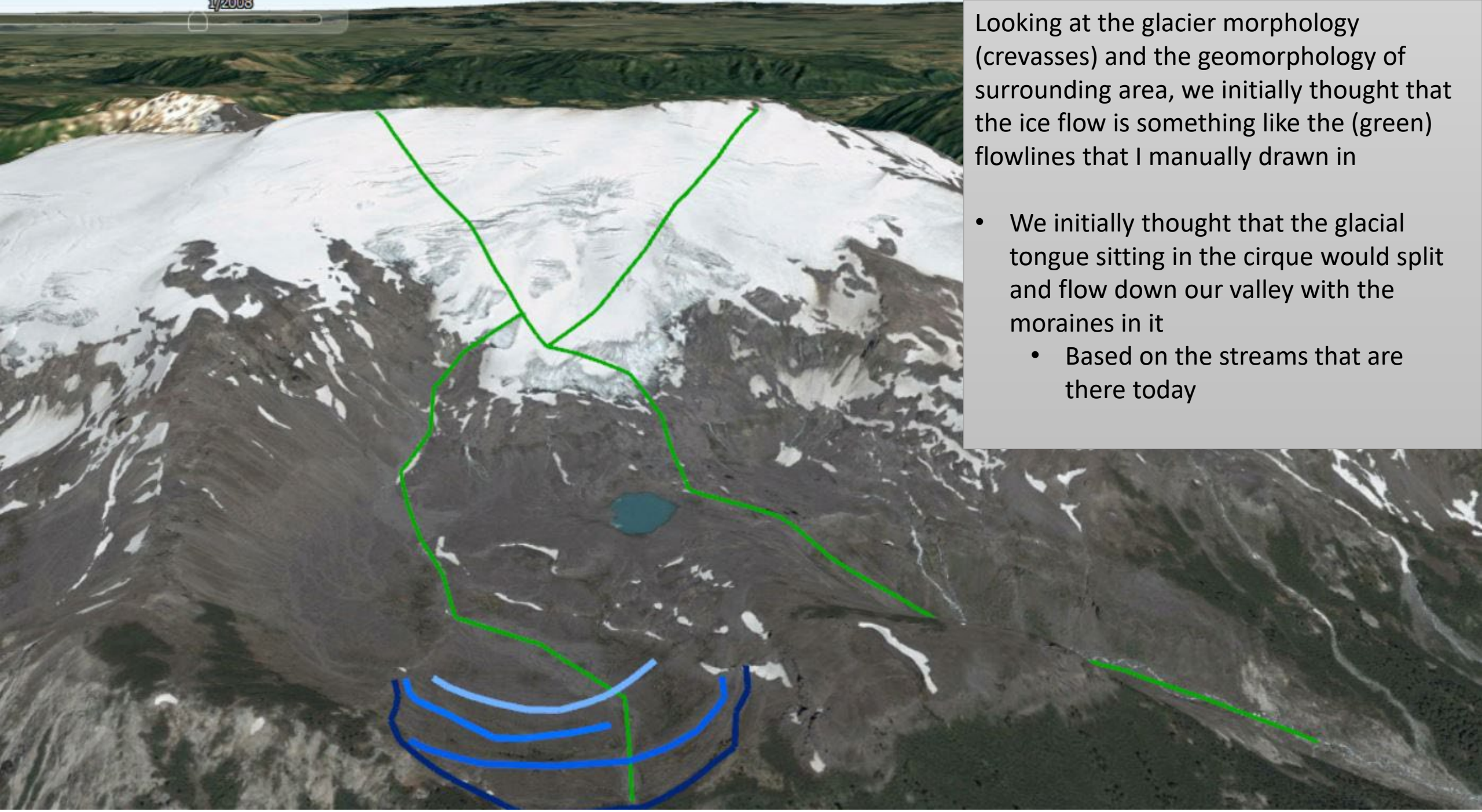


Main Glacier: RGI60-17.12795

- Terminal and recessional moraines mapped (various blue lines)
- Boulders located atop moraine ridges were dated using 31-Cl cosmogenic dating methods (white points and values)

Goals of project:

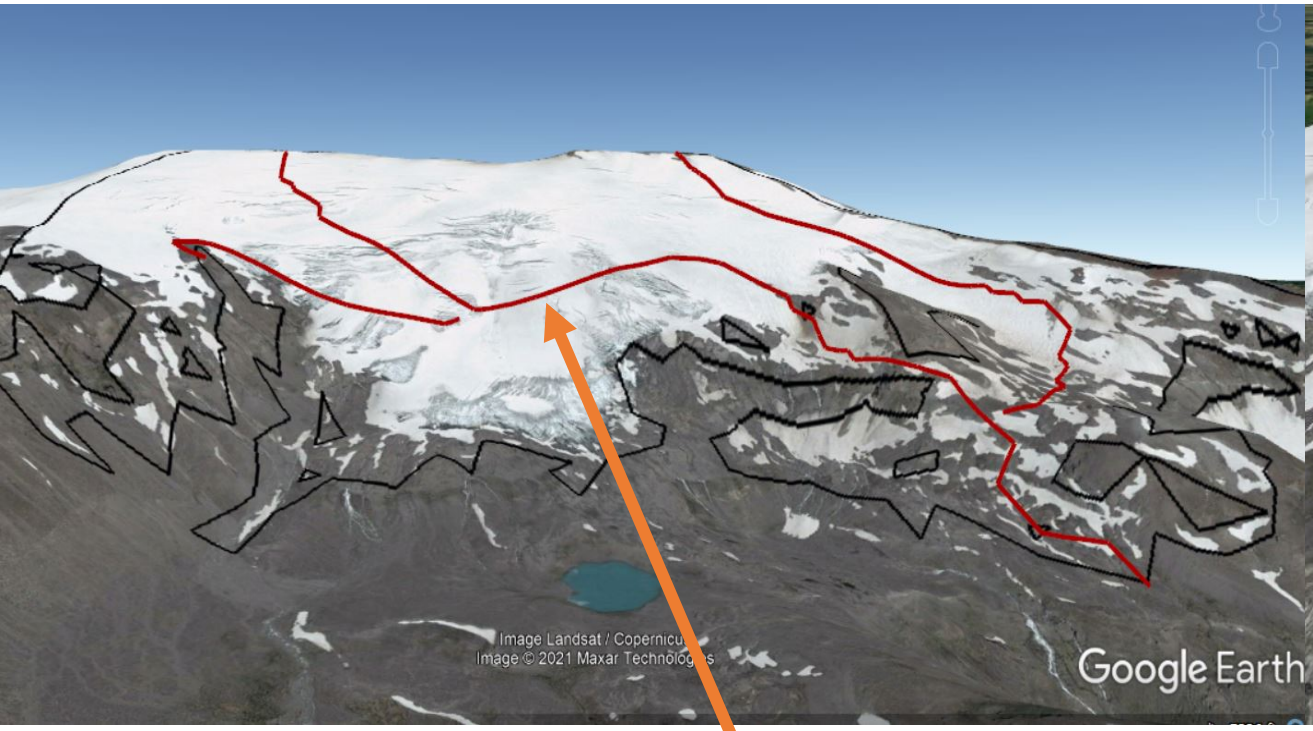
1. Determine a plausible climate scenario that will result in the modern glacier to grow out to the LIA ice extent
   - i.e., glacier reaches dated moraines
     - Since moraines are periods of neutral mass balance (stasis)
   - Precipitation and temperature changes limited by tree ring data analysis
2. Perform a sensitivity analysis to quantifiably determine the influence of temperature and precipitation on this glacier's mass balance

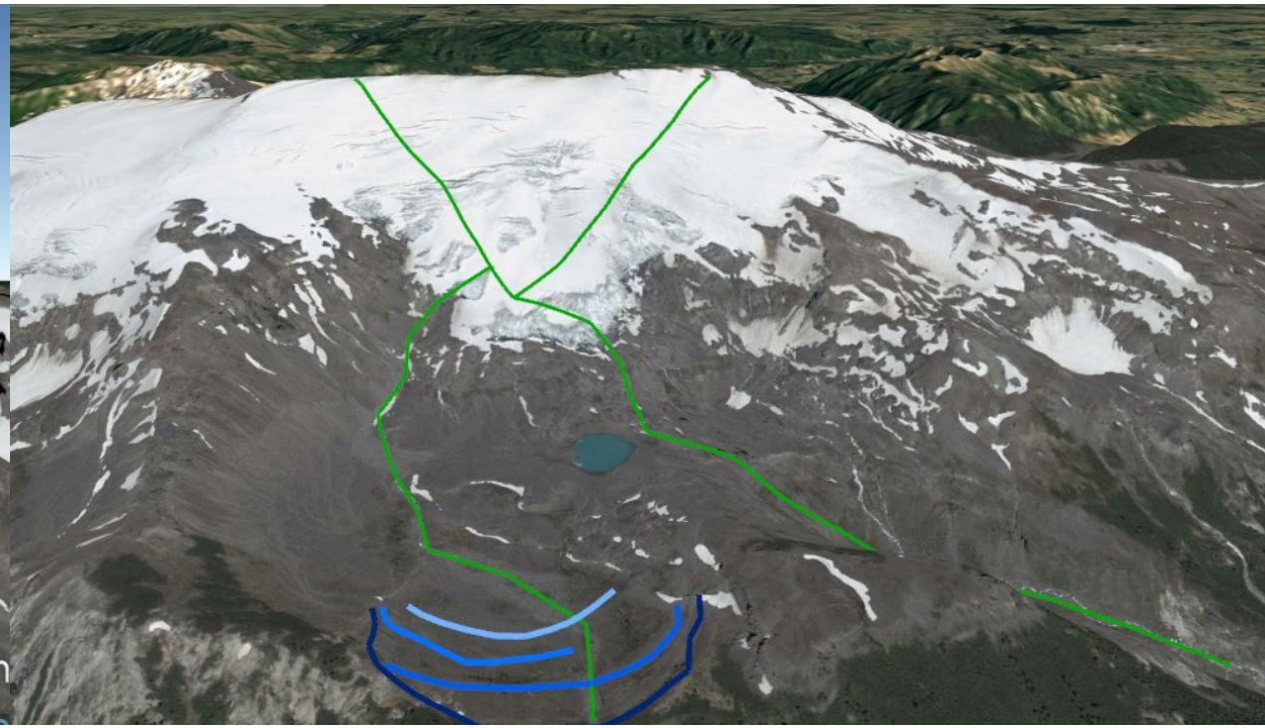


Looking at the glacier morphology (crevasses) and the geomorphology of surrounding area, we initially thought that the ice flow is something like the (green) flowlines that I manually drawn in

- We initially thought that the glacial tongue sitting in the cirque would split and flow down our valley with the moraines in it
  - Based on the streams that are there today

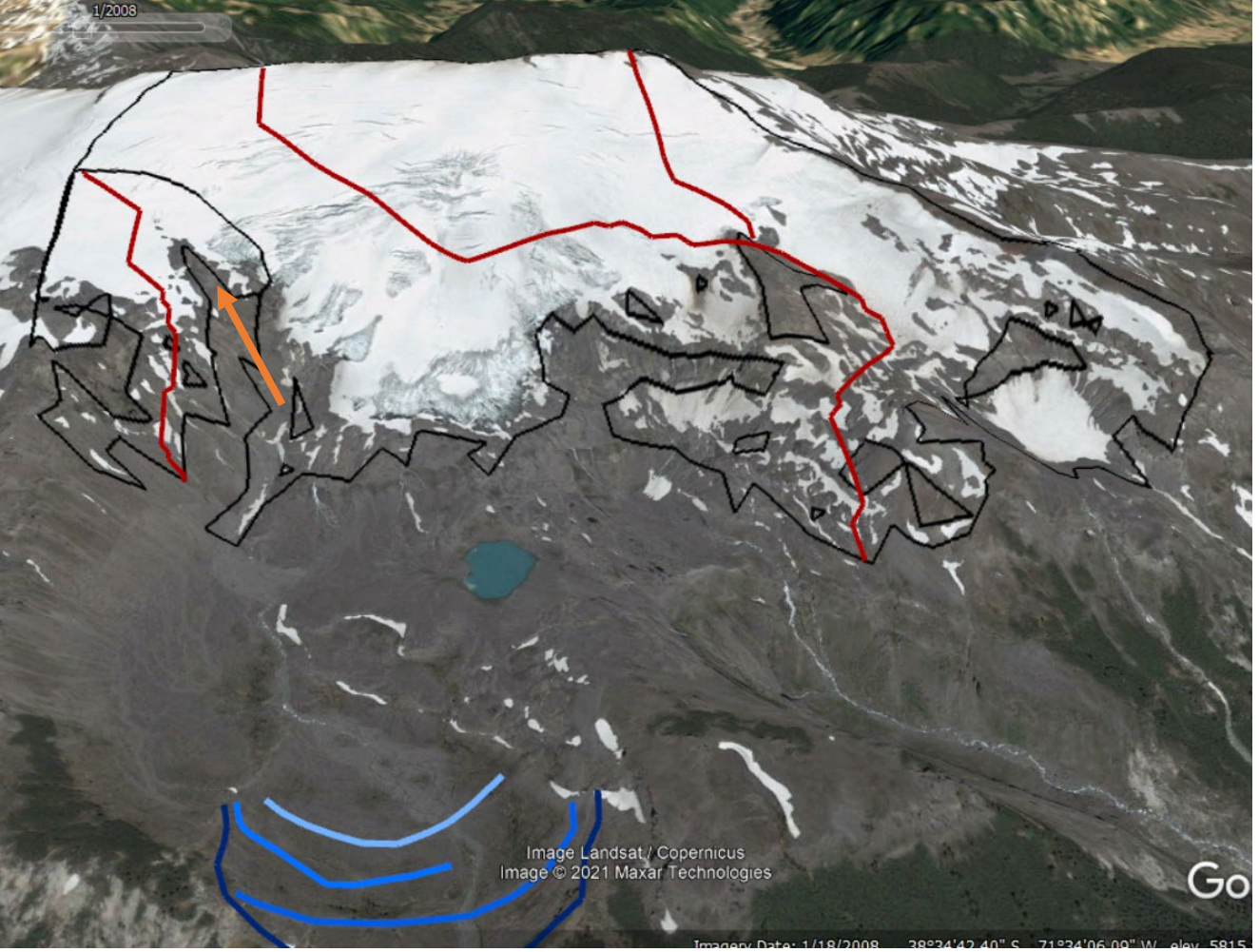
However, when we ran OGGM (following the tutorials closely and using the RGI ice extent) we ended up with flowlines that do not follow the geomorphology

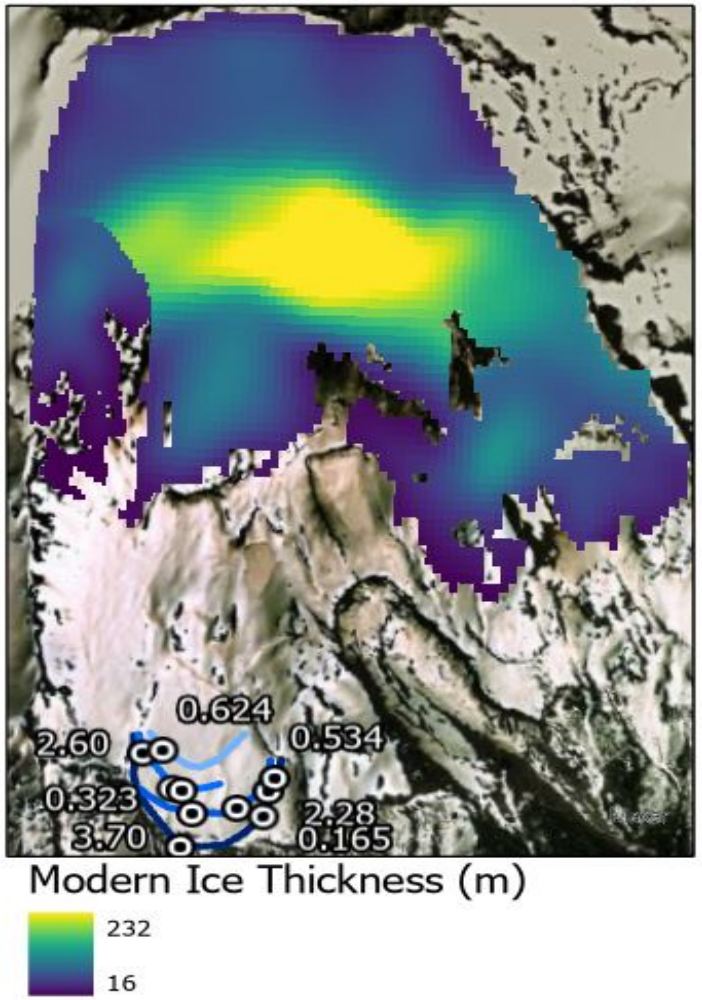




The main flowline turns suddenly, climbs up the cirque face and goes down a more complex path

Again, modern runoff from the glacier continues downward towards the glacial lake

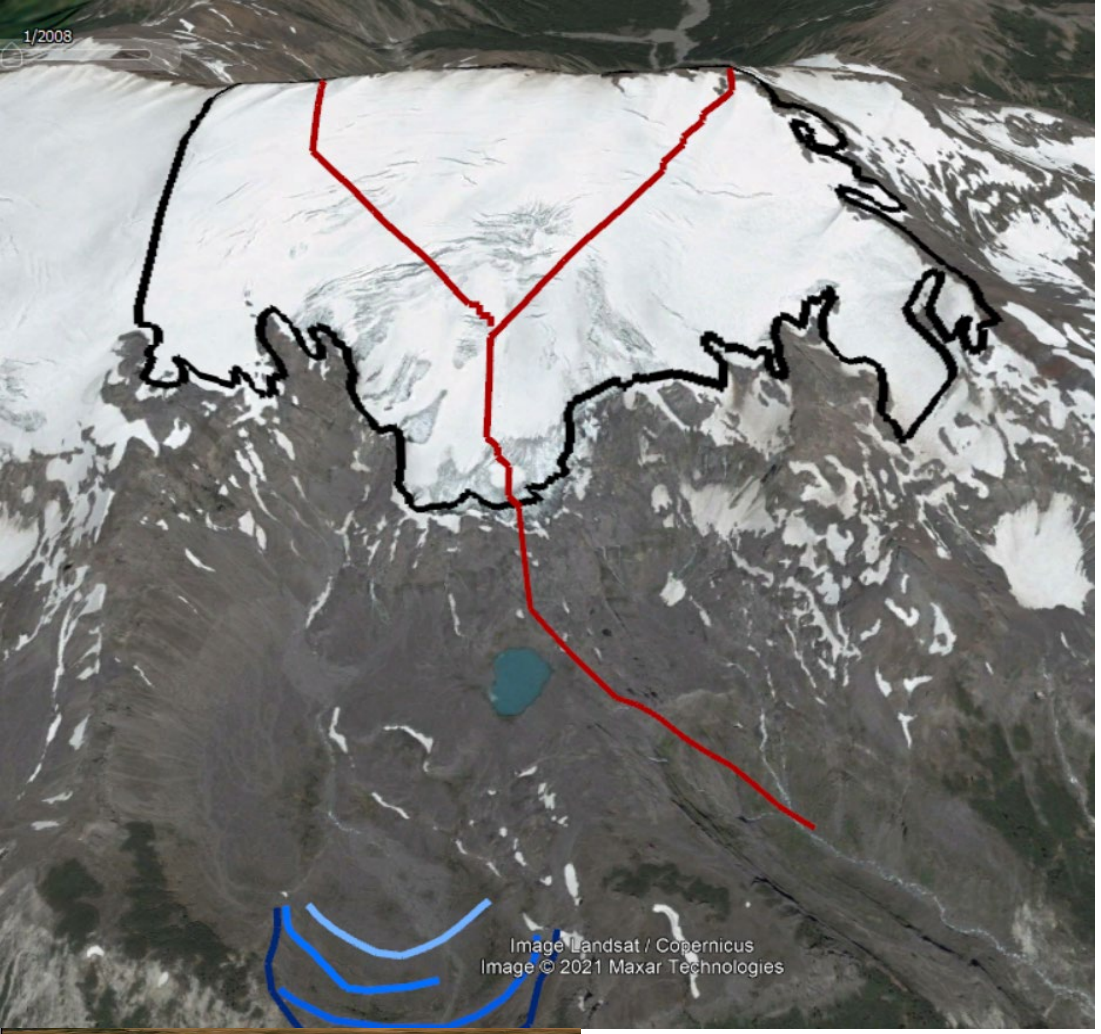


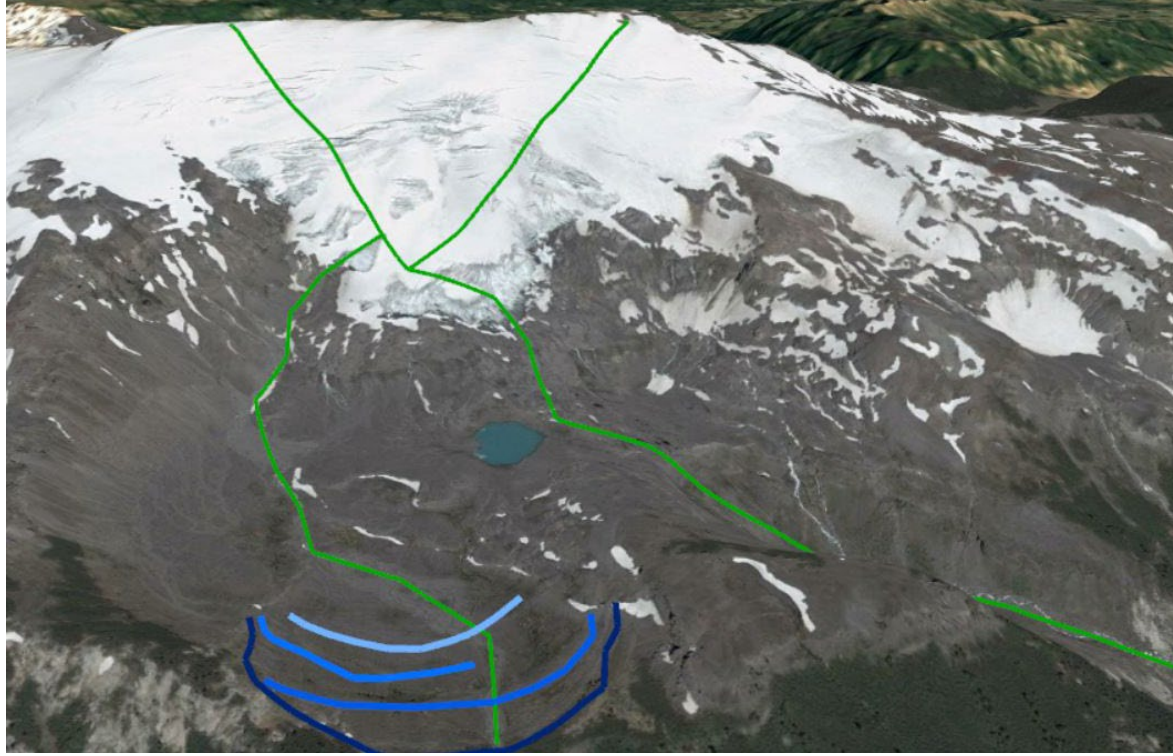


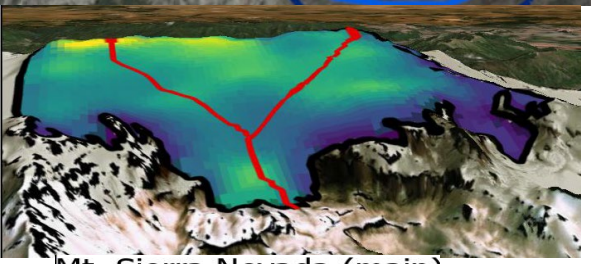
Splitting the RGI ice extent did result in a flowline that did eventually reach down to our moraines, but the ice thickness is more than double what the field data shows.

Also, this does not fix the weird sudden turn in the cirque

I will admit, where I split the glacier could have been better (closer to where the orange arrow is pointing…), but I don't think that it would have solved either problem



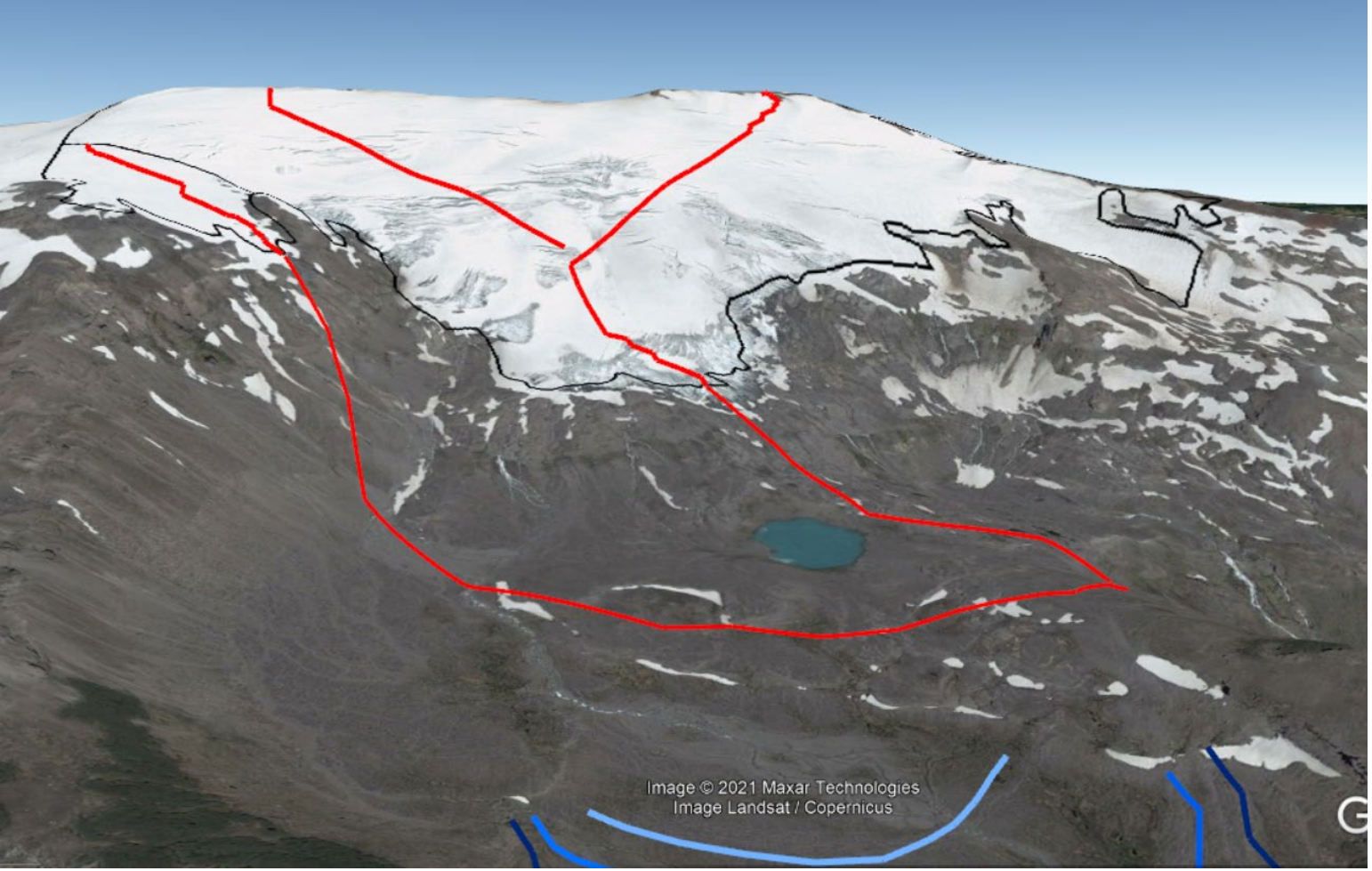


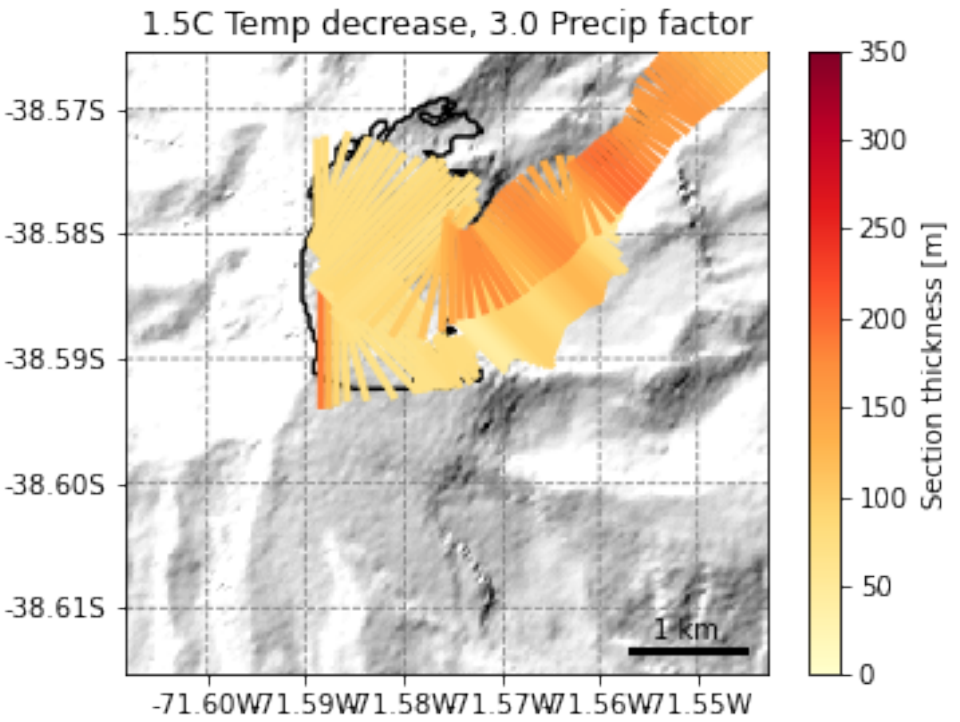


Dr. Alphonso Fernandez from the University of Concepcion (Chile) and his grad student have been mapping the glaciers on Mt. Sierra Nevada and have created a new ice extent shapefiles based on field and satellite 2011 ice extent

The flowlines that OGGM calculated are very similar to the manually drawn flowlines (green). But there is no indication that there is any ice flowing down our valley

On the plus side, the calculated ice thicknesses are more reasonable for this glacier

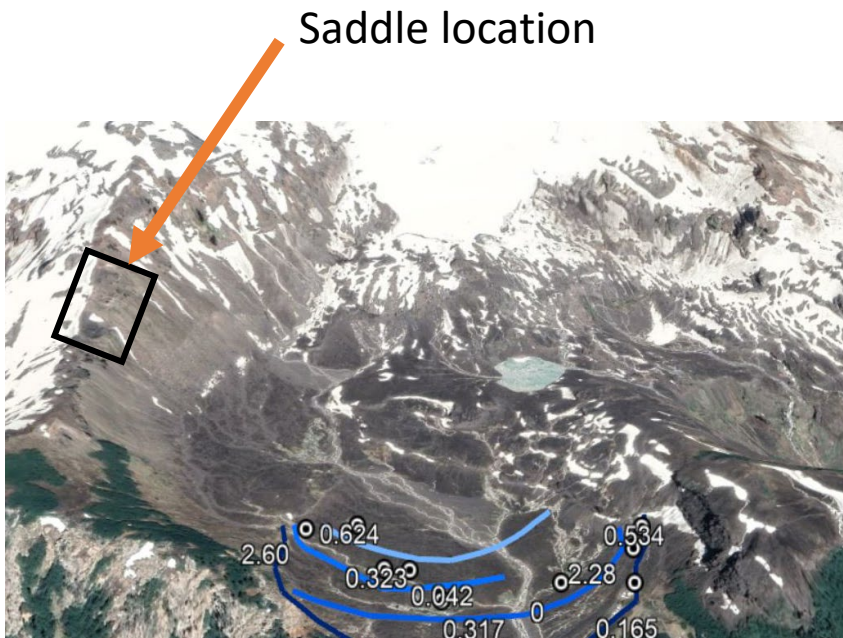


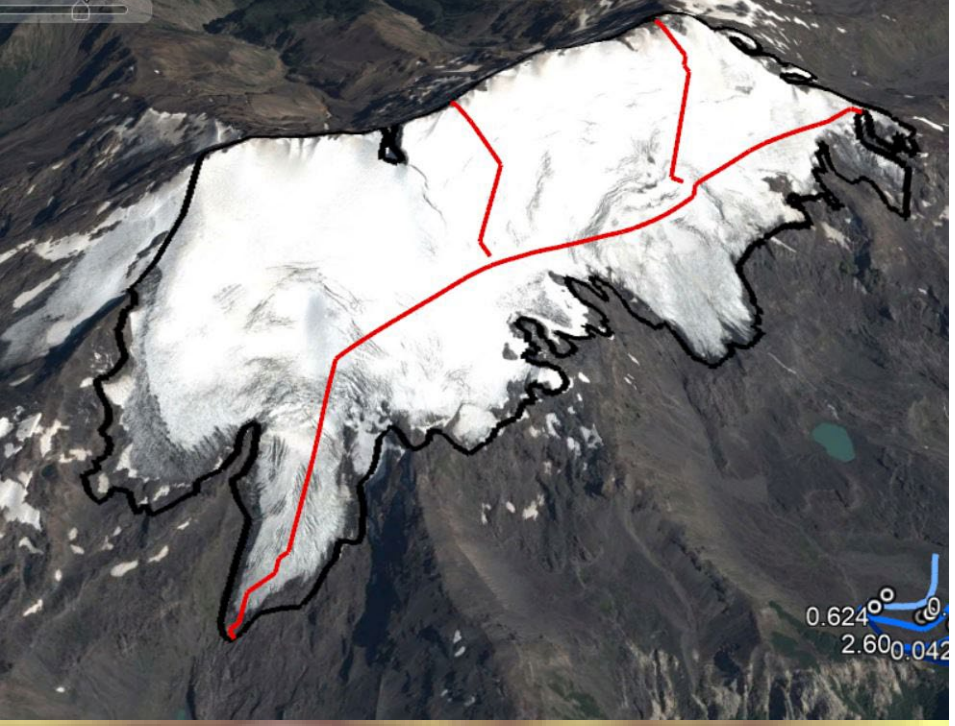


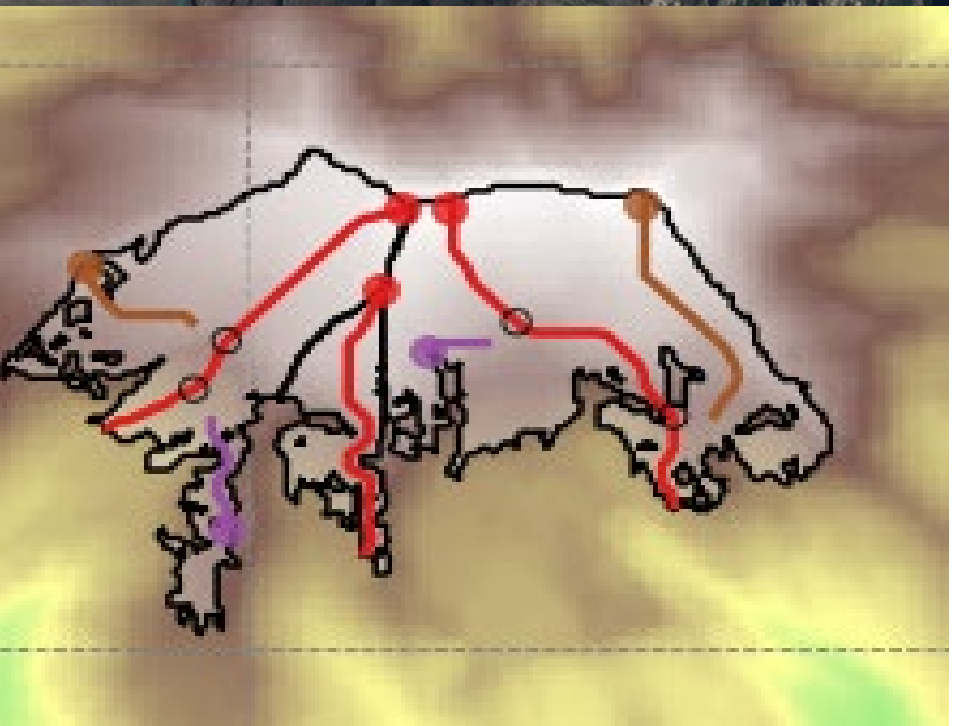
Splitting Alphonso's 2011 ice extent shapefile into two glaciers, did result in a flow that initially went down the right valley. But once the ice becomes thick enough, it then the flow goes over the ridge near the glacial lake and merges with the main flowline down the steep valley

Alphonso suggested that we should treat Mt. Sierra Nevada's glaciers as an icecap or consider that the glaciers to the south contribute somewhat to our ice flow

And looking at the geomorphology more closely, there appears to be a saddle on the southern ridge that bisects a lateral ice thickness feature (dashed blue lines), which the feature is likely older than the LIA. We think that at least some ice from one of the southern glaciers flowed down this saddle and contributed to our flow and got the ice to reach the dated moraines







Merging the glaciers on the Eastern side resulted in a flow that flies in the face of the physics

Then followed the tutorial that uses the **Workflow.merge_glacier_tasks** command

Results:

- None of the glaciers merged, even when I cycled through and changed which glacier was considered the ‘main glacier’

I know that there are some limitations right now for this task:

- Some glaciers don’t merge because their downstream line does not reach the ‘main’ glacier’s downstream line
  - Especially true for smaller tributary glaciers since their domains are also smaller
- Cannot make a glacier where there is none today
  - Limits the time that we can go back into the past

Next options:

- Create a shapefile on the saddle to trick OGGM into thinking there is a glacier there

- Create my own flowlines in arcgis, making sure that the file is identical to all the information in OGGM’s calculated centerline