Example of teaching with 3D printed terrain models at Iowa State University

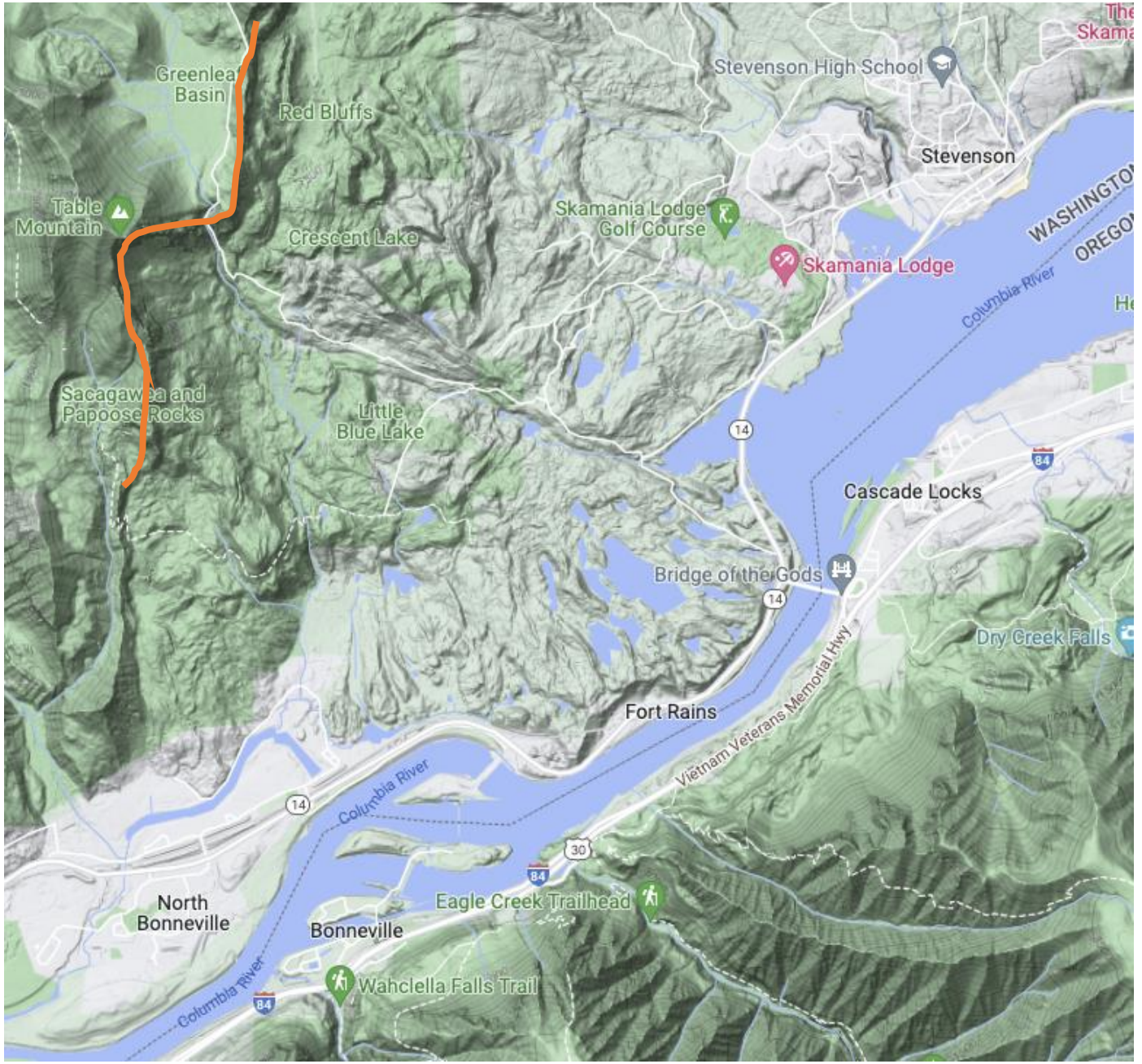
2:50 – 3:05

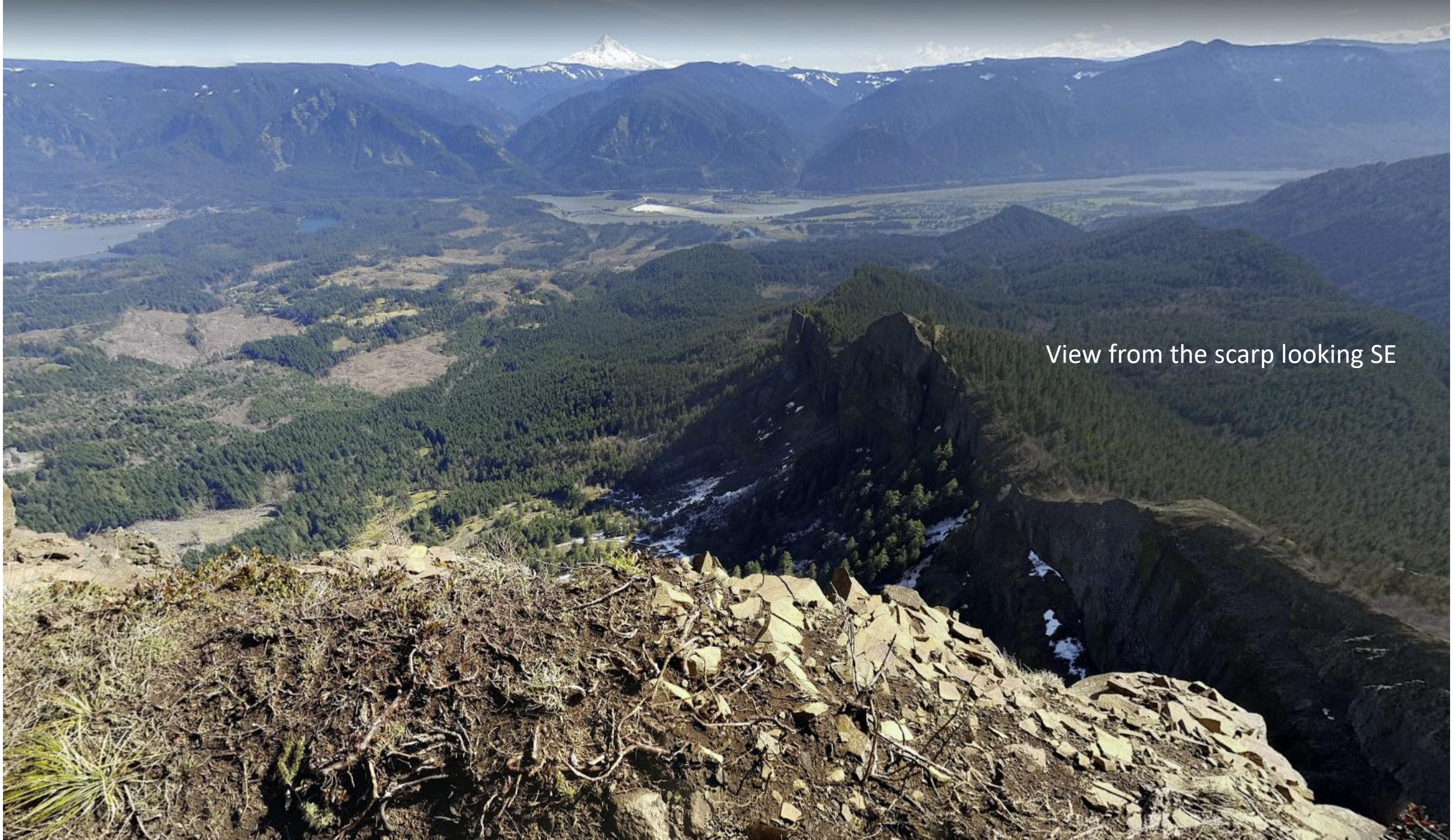
Columbia river (Bridge of the Gods) exercise

- Geol 101 – topographic map reading (part 2 of 3)
- Large service class (~ 200 students, most non-geology majors)
- Split in groups of ~ 5 students, each group was given a 3” x 4 ” terrain print and a topo map of the larger area of the same scale
- (a large model was also given to the teacher to point at during orientation)
- Task 1: place the print at the right position on the topo map
- Task 2: Identify the area of the Table mountain slump
- Task 3: With a soft pencil (provided) indicate the scarp on the 3D model (snapshot, graded) and also transfer it to the topomap (graded)

Post-mortem:

- 3D models were perceived as “cool”
- Placing the model took longer than expected
- Most would not have identified a slump based on the topo map alone, but it was easy on the model
- Most found the scarp quickly, all could see it once pointed out
- All data was anecdotal, no pre-post test was done





View from the scarp looking SE

Geol 100 Lab – Ames flood risk exercise

- Topo map and satellite image of Ames, location of USGS gage station, flood recurrence table
- 5 students share a large 3D terrain model of Ames (x 5 elevation scaled!)
- Estimate the elevation of the stream bed at the USGS gage station
- Determine which peak discharge events correspond to actual floods
- Locate 5 points of interest on topo map (Stadium, Walmart south, etc.) and determine for each:
  - 1) What is its elevation?
  - 2) Would it flood during a 50-year flood?
  - 3) Would it flood during 100-year flood

- Generate a flood risk map for a 50-year flood and a second for a 10-year flood.
- Make a recommendation for further developing the floodplain near the USGS gage station.
- Post mortem:
  - Again, only anecdotal
  - Liked working with local area
  - 3D map much more useful than topo
  - (would have liked to draw on 3D map)
- Idea: fill up model with water to simulate flooding (*)

Structural geology (1)

- Field trips to Death valley (2018 and 2021)
- Large 3D print of death valley used in pre-trip planning and during the trip
- Single large 3D print
- Orientation while traveling through the landscape
- Identify major elements (e.g. alluvial fans)
- Postmortem:
  - Very easy to orient where students stand and what they are looking at
  - Large size slightly impractical
  - Liked to have major formations drawn on the model

Structural geology (2)

- ISU summer field camp in Greybull, WY
- 2019 through 2022, one of 6 major exercises (6 week course)
- Mapping the Alkali Anticline
- One small 3D print per mapping group (3-4), topo map and satellite image
- Pre-walk: What are the major structural elements?
- During walk:
  - What is a good path to walk?
  - What should we expect as we walk around?
  - Where withing the overall structure are we standing now?
  - Make annotations on 3D map (pencil) and topo map

Postmortem:

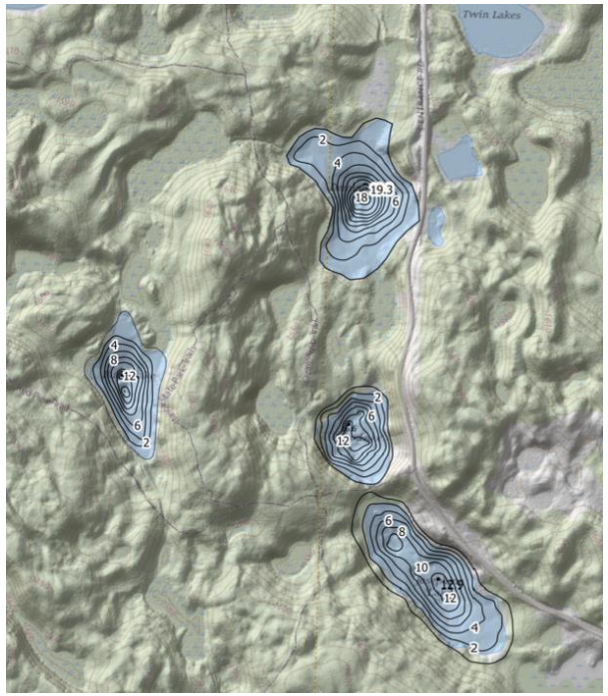
- 3D map had concrete “practical” value during the walk
- Despite the smaller scale of the 3D map, students had no issues “jumping” between them.
- Annotating the 3D map was seen as very helpful for later developing the structural model
- Overall, different degrees of 3D map for the entire exercise
- Increased motivation(?)

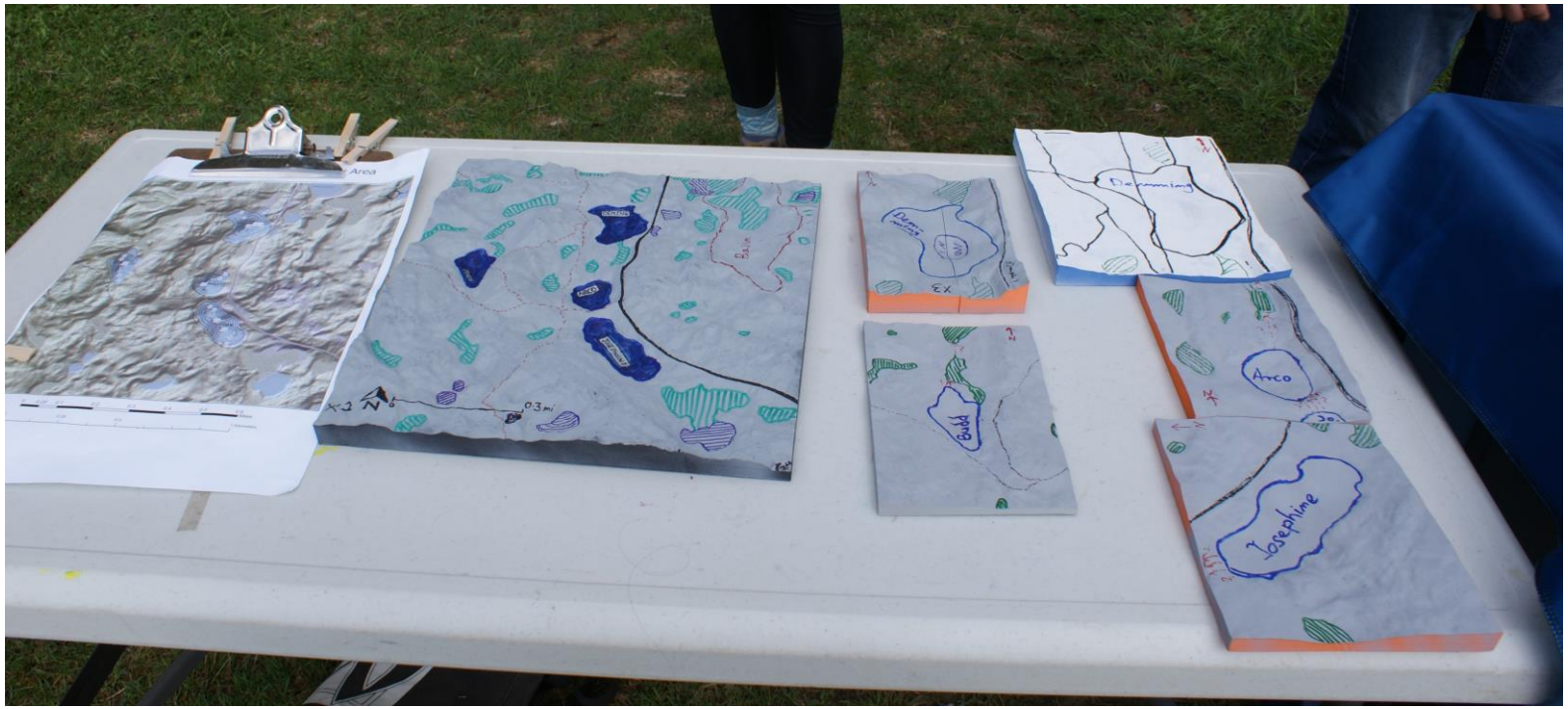
Next steps:

- Larger 3D maps for each group or maybe one very large 3D map at the field station
- Integration with iPads for Google Earth?
- Use 3D maps in more exercises

Limnology fieldtrip to Itasca State park (2022)

- Research into 4 small, meromictic lakes (deep enough to not ever mix)
- 400/500 level research-heavy course with an small outreach component
- 3D printed a large overview map and 4 local maps (1 can be profile-flipped)
- Hand annotated via colored Sharpies (lakes, swamps, roads, basin)





- Overview 3D map was z-scaled to bring out the position of each lake in the landscape (suggesting possible gravity driven flow between them)
- Easy to show the different types of lake basin morphologies
- Outreach (elementary to high school students): 3D models were useful to first grab their attention and then explain the science with them.

Postmortem

- 3D models can be effective in some research settings and for outreach
- For outreach: no computer needed for 3D was a huge plus in the specific setting.

In development: Grand Canyon flip-Profile

Geol 201 Topographic map reading exercise (how profiles work)

- Have students draw a 2D profile along the major contours (500 ft)
- Flip the 3D model and compare with your drawn profile
- Designate surface points along the profile and ask: can X see Y?
- Learn about the relation of slope angles (3D profile) and contour line density (topo map)

Structural geology(?)

- Paint the profile below on the 3D profile