Methods to Scale and Align Point Clouds from SfM

- Single card ground control points
  - Easy to align to north and gravity
  - Good for 1-5 m surveys

- Distributed GCPs (5 to 1000 m separation)
  - Laser rangefinder with inclinometer and compass can be used to find local coordinates: cheap, lightweight, fast, and decimeter accuracy
  - Total station combined with GPS receivers: heavy, expensive, and precise to mm

Ground Control Points (GCPs)
- Small rigid objects with measurable points
- High visibility in point clouds
- Align to gravity
- Align to north
- Locate in a georeferenced world

What’s the End Game? Why spend time on 3D data with undergraduates?
- Point clouds define shape, and shape is linked to process
- Introduce students to forces in real world settings (stream hydraulics, for instance)
- Concave profiles on landslide surfaces highlight runoff erosion
- Convexity on landslide surfaces reveal recent incision
- Change detection is possible over an entire area
- Are the complications of the 3D world hindrances to learning?

The Reality of Teaching SfM, or what I learned after 2016 season
- This is not a 1 hour exercise! Lots of moving parts: cameras, softwares, and scientific goals for using the data
- Video tutorials are very helpful
- Multiple survey experiences, starting in the classroom, can build confidence and familiarity with workflows
- Be aware of lighting and texture in the feature to be captured
- Things that stymie learning: Poor alignment of cameras or too many cameras (lousy 3D model, or waiting too long...)
- Provide purpose for the survey: learn from multiple perspective views, develop skill sets, answer process-related questions

Students value the SfM learning experience; survey after 4 weeks

Fall 2018 SfM Teaching Approach: More is Better!
- 5 week module provides several formative experiences
- Week 1: Learn SfM in class (Agisoft PhotoScan Standard + Cloud Compare to scale and align point cloud)
- Week 2: SfM of geomorphic hillside features, such as tree throw mounds, hillside creep, rock capped pedestals; group activity
- Week 3: Landslide SfM, single sheet GCP; group activity
- Week 4: Hydraulic geometry in bedrock and alluvial channels, multiple GCPs shot with total station, or tape-compass; group activity
- Week 5: Summative experience; each student documents geomorphic features in a post-glacial gorge

Acknowledgements: Thanks to SUNY Oneonta students in Geological Data & Analysis, and Geomorphology 2016-2017 for wrestling with poorly designed workflows and recalcitrant software.