

Photogrammetry

Use of AgiSoft PhotoScan in support of NRSS activities



A short introduction...

- **Geologist/GIS Specialist [Guest Scientist]**
- Working with the Geologic Resources Division
 - Background in Chemistry (BS) and Geomorphology/Geology (MS)
 - Interests in...
 - Quaternary Aeolian, Fluvial and Glacio-lacustrine systems
 - Paleoclimatology
 - Geographic Information Systems
 - Remote sensing
 - Caves/karst



A bit about...

- **Photogrammetry**

- Use of photographs to document landforms and objects

- Multiple applications to remote sensing

- UAV and manned aircraft

- Rendering of subjects in 3D virtual environment

- Combined with spatial and temporal data

- Qualitative and quantitative assessment on

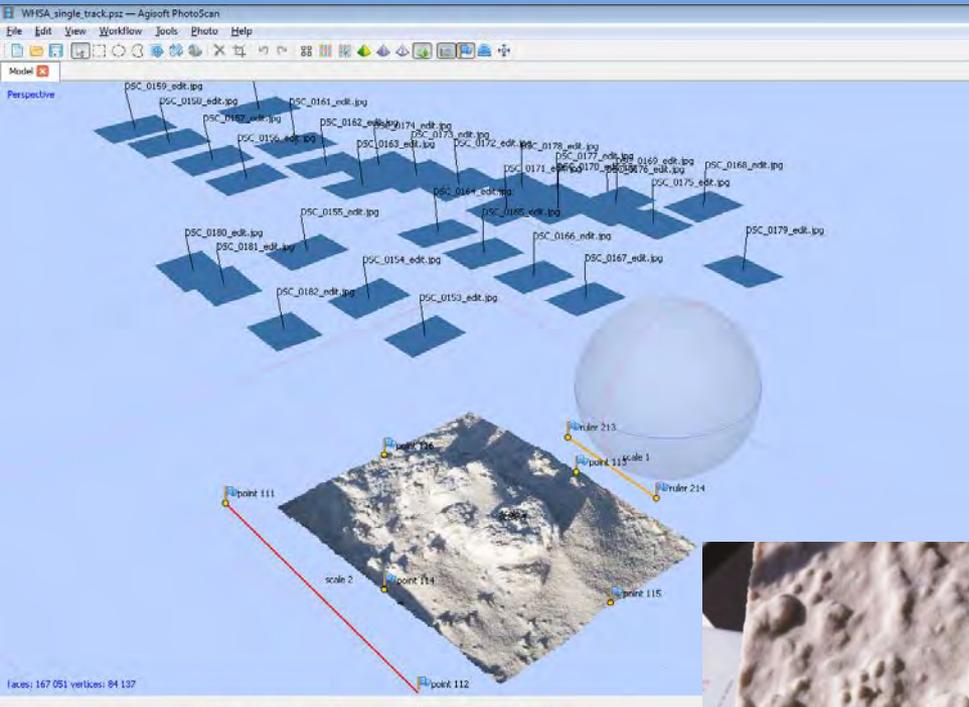
- Geo-hazard and landscape stability

- Anthropogenic impacts

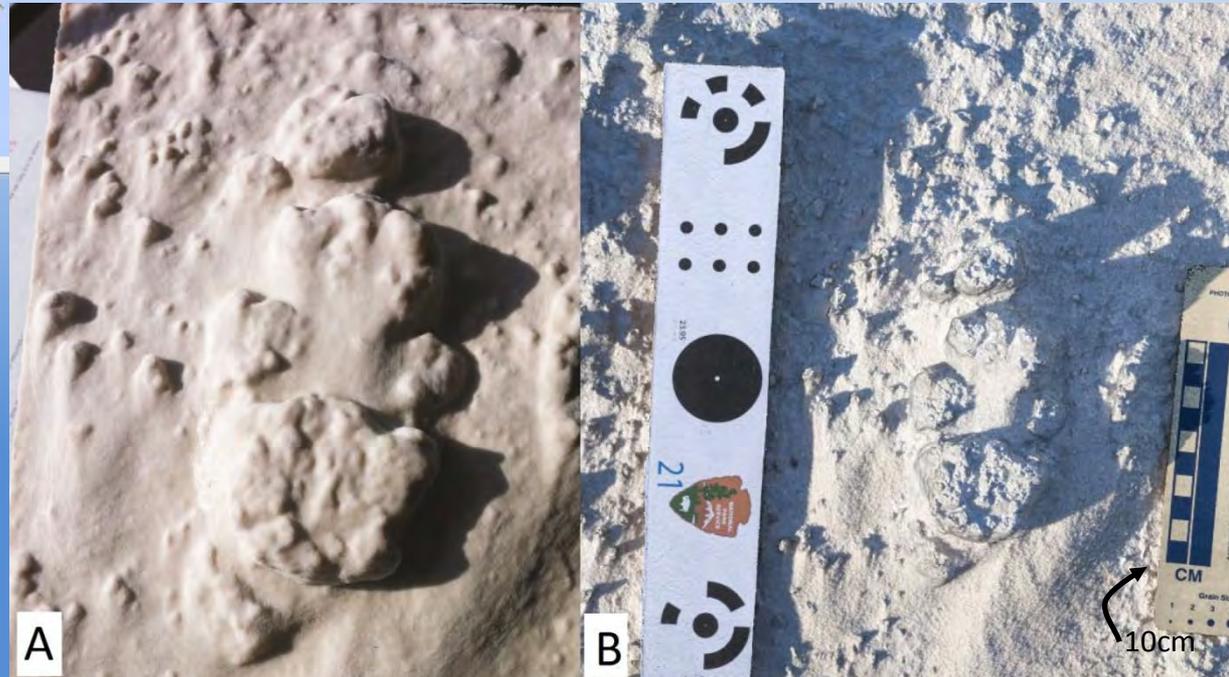
- **Agisoft's PhotoScan**

- 3D software for photogrammetric analysis

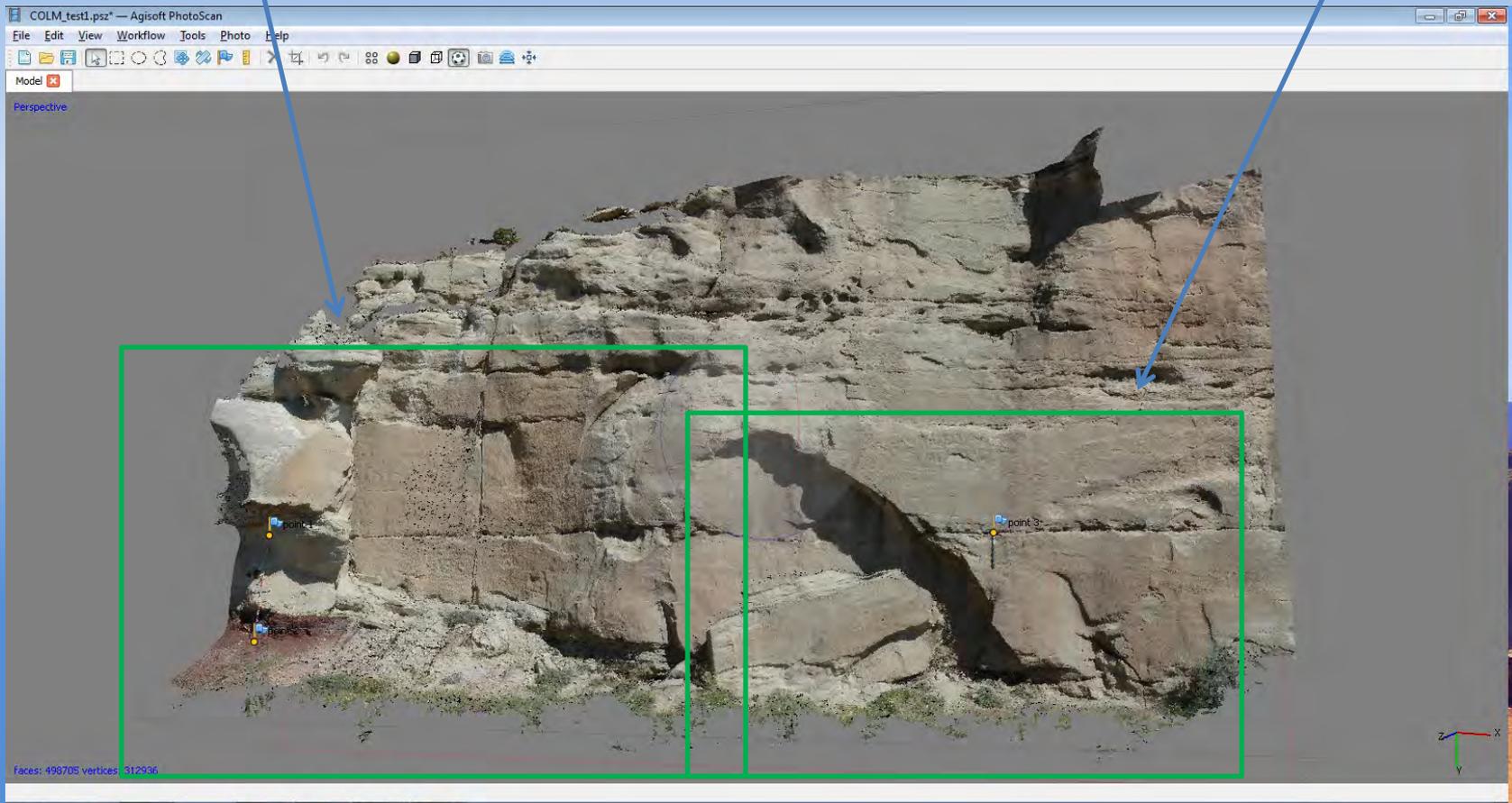
Close-range Photogrammetry



- Fossil track from WHSA
- Data used to generate 3D-print



- Geohazard applications



Challenges of use...

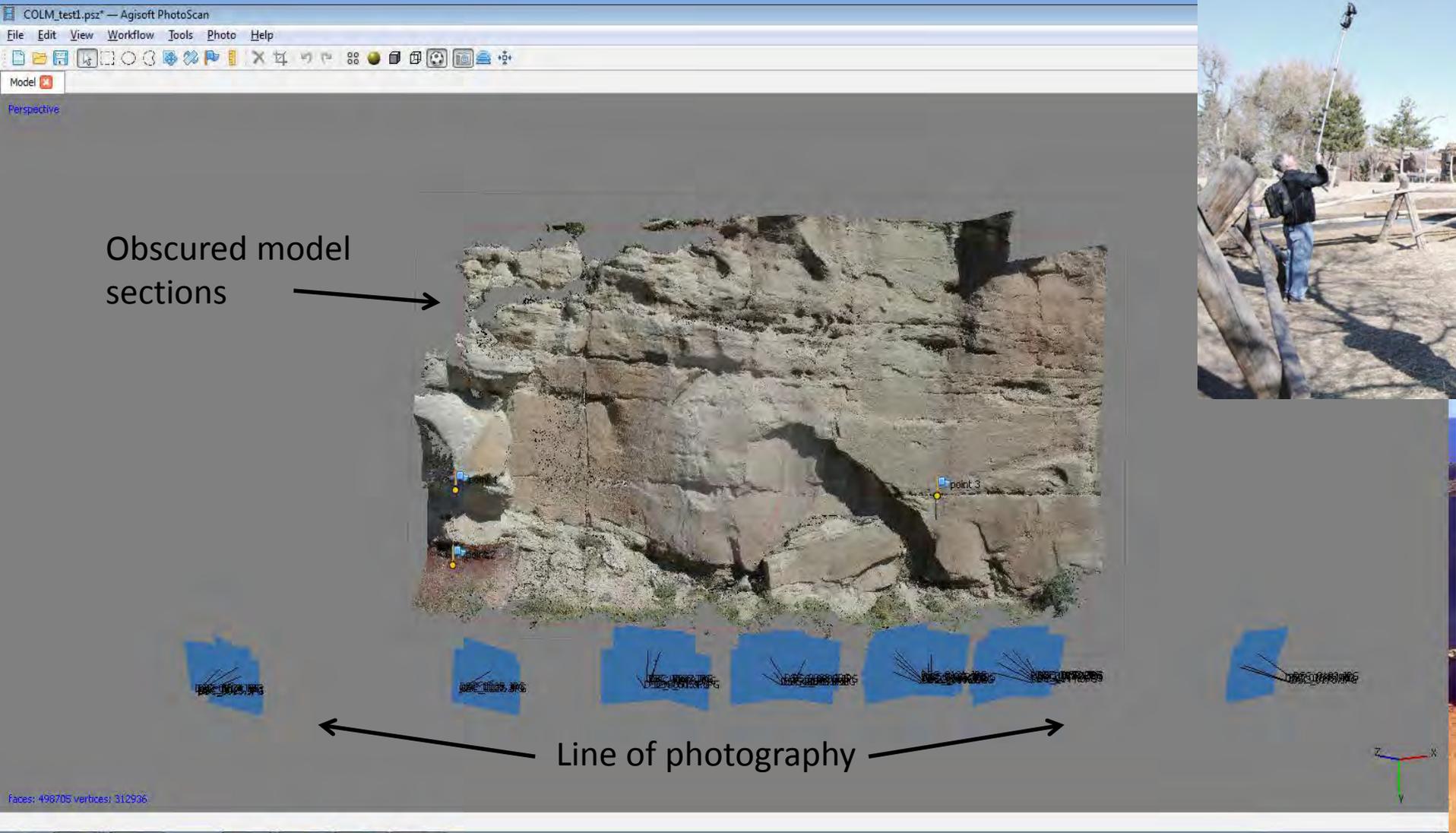
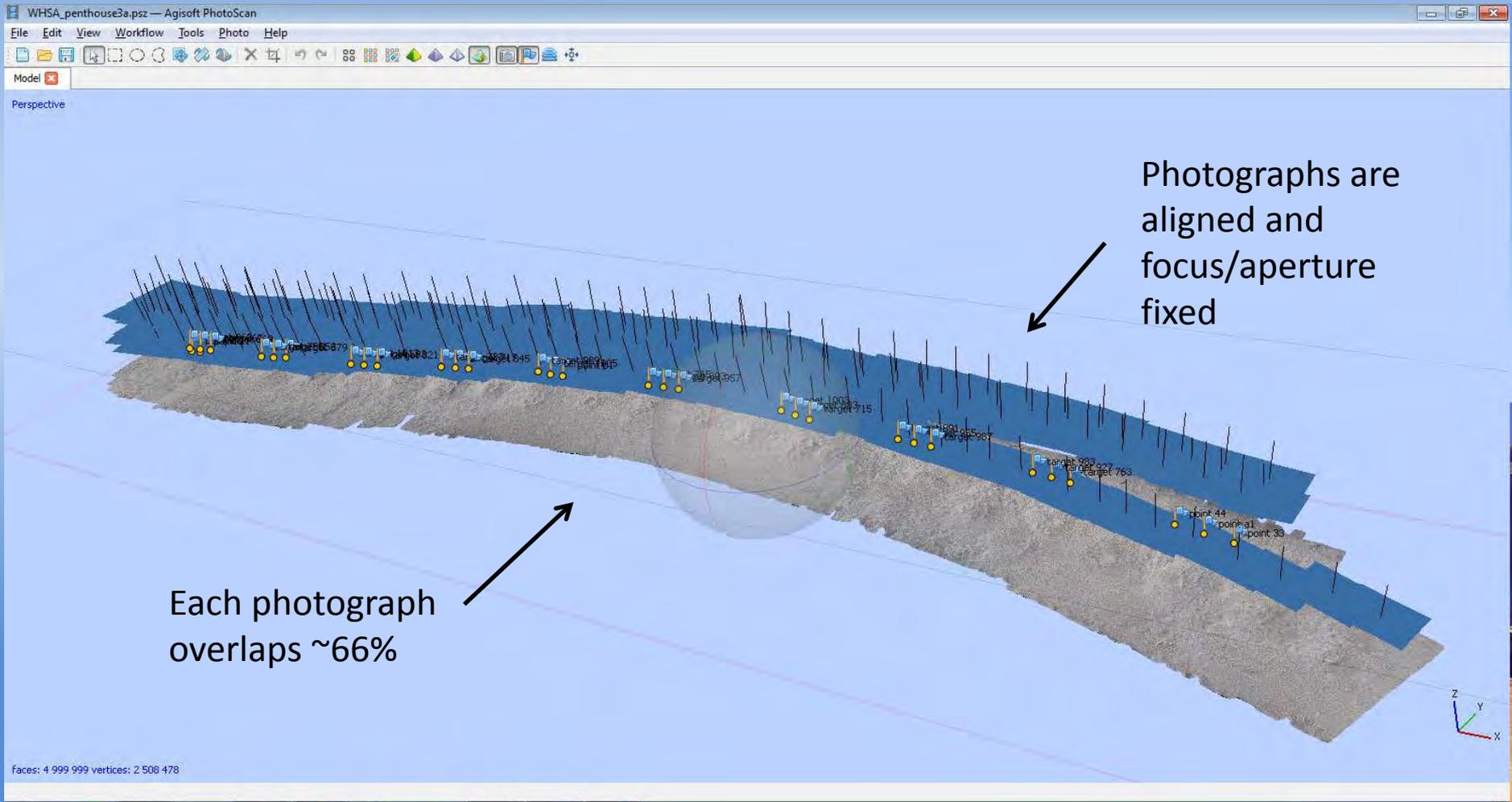


Photo-alignment on the ground



Applications in Remote Sensing*

- Little difference between near- and long-range applications
- One-time efforts:
 - Base imagery maps down to 5 cm resolution for GIS analysis related to science, infrastructure, etc
 - Base DEMs down to **5 cm resolution** for GIS base, hydrologic modeling, topographic analysis, etc
 - Example uses: base layers for vegetation maps, infrastructure identification, locating field sites and transects, 3D terrain visualization, project outreach, etc.

*list modified from Matt Nolan – UAF

Remote Sensing

- Time-series maps with these characteristics can be used for:
 - Measuring volume change,
 - Detecting and measuring changes in the ground surface – Mass wasting/ ground creep
 - Measuring coastal erosion
 - Monitoring mining progress and making hazard assessments
 - Measuring snow pack thickness
 - Measuring NDVI* and other vegetation changes seasonally or annually
 - Monitoring infrastructure degradation
 - Monitoring construction progress

* Normalized Difference Vegetation Index

UAS operations

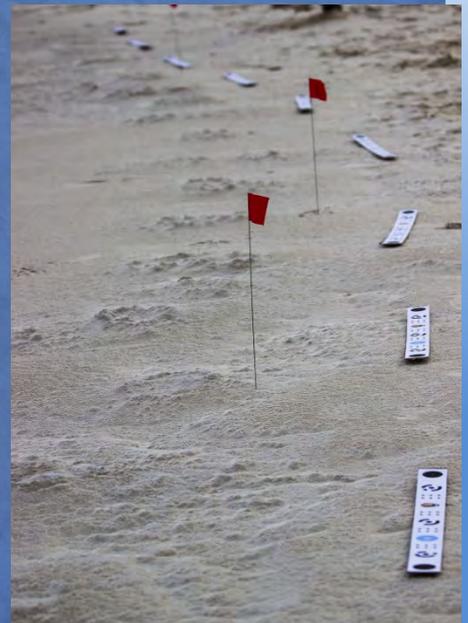
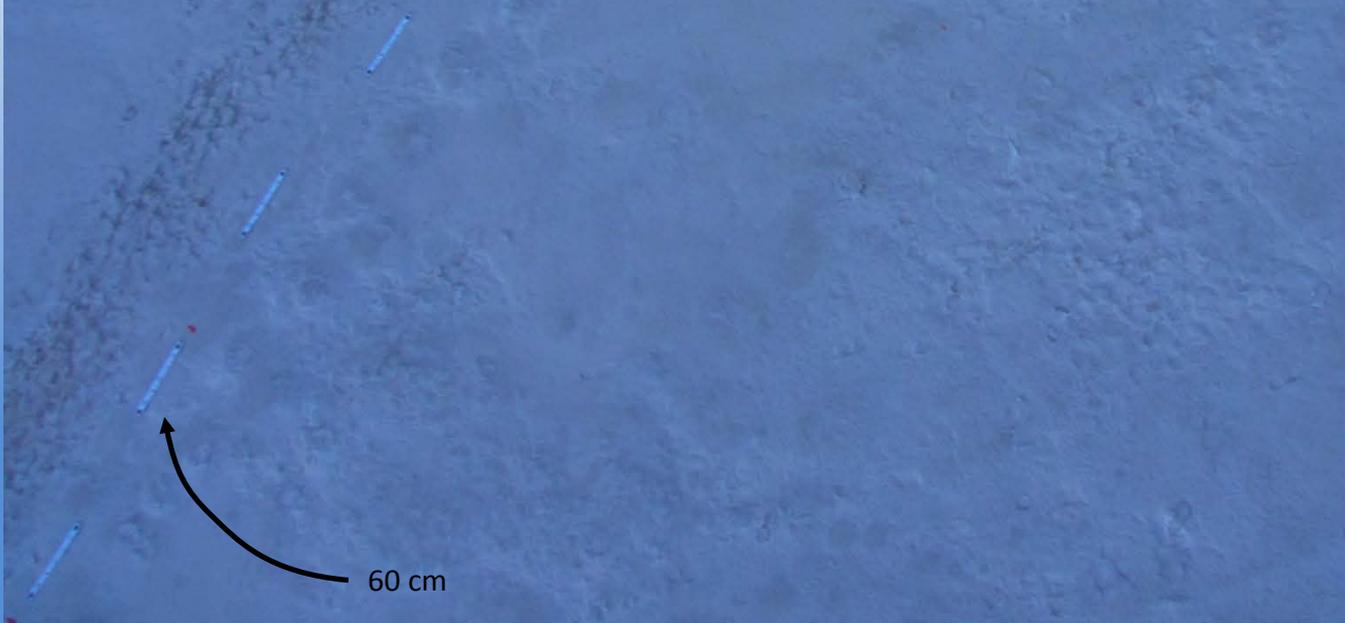


- UAS based photogrammetry
 - Capable of cm-scale resolution (1 cm pixels)
 - Low-cost alternative to manned aerial platforms for
 - LIDAR
 - Air-photosets



UAS operations

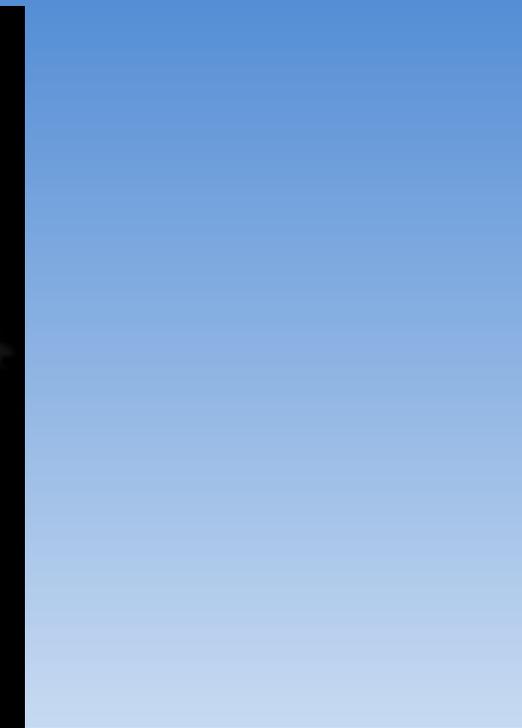
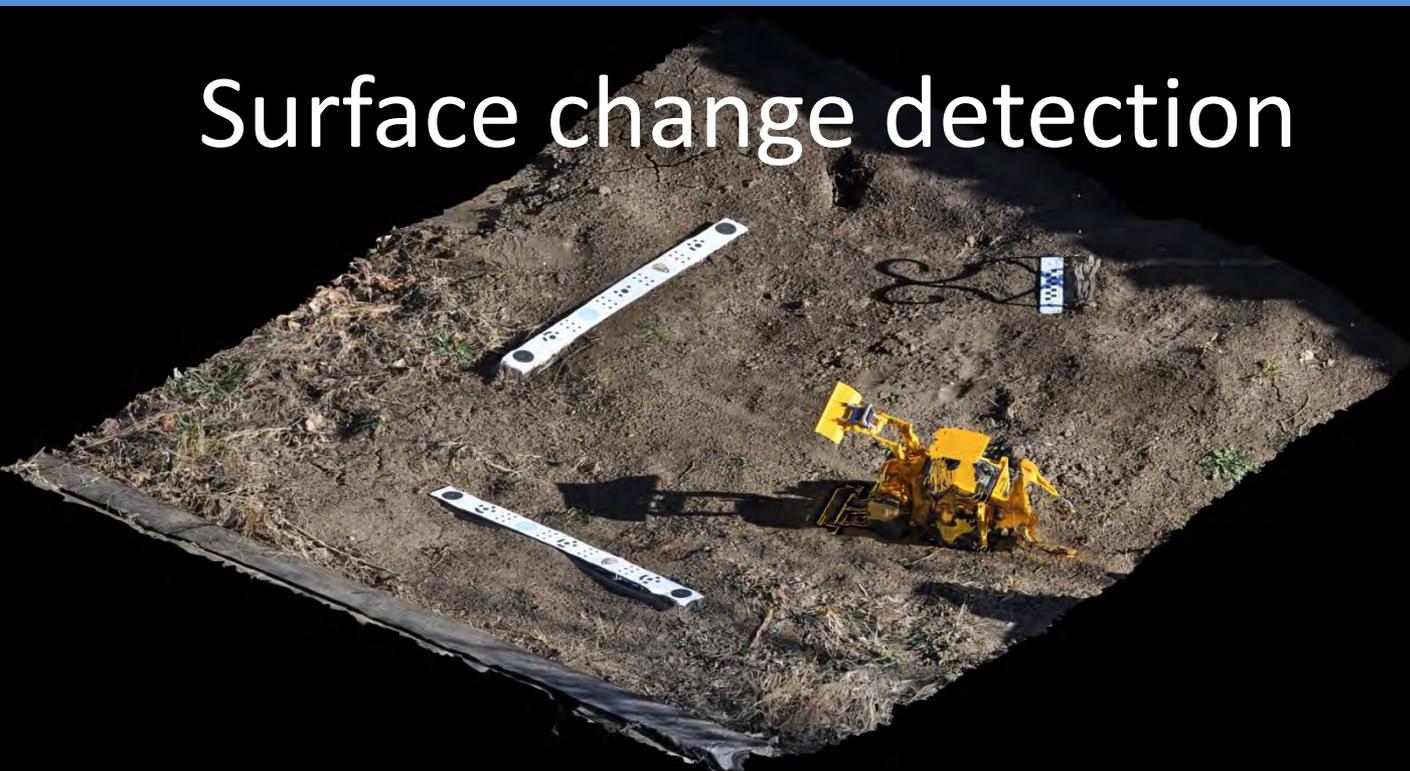
- UAS based photogrammetry
 - Drawback – platform vibrations lower resolution
 - Payload capacity limits camera type
 - Ground-based can use DSLR
 - Aerial can only use point-and-click
- Can combine data sets



Projects to date

- Colorado NM - [COLM testing.pdf](#)
- Gettysburg NMP
 - [Whole block - anchisauripus](#)
 - [anchisauripus detail](#)
- White Sands NM
 - Photogrammetry to [3D-printing](#)
 - Monitoring of Pleistocene mega-tracksite
 - Ground based and UAV photogrammetric data sets
- Morrison-Golden Fossil Areas NNL (aka Dinosaur Ridge)
 - [Triceritops track](#)
- Example digital terrain model
 - Output to ArcMap or [Google Earth](#)

Surface change detection



- Image registration
 - Ground controls or GPS enabled camera

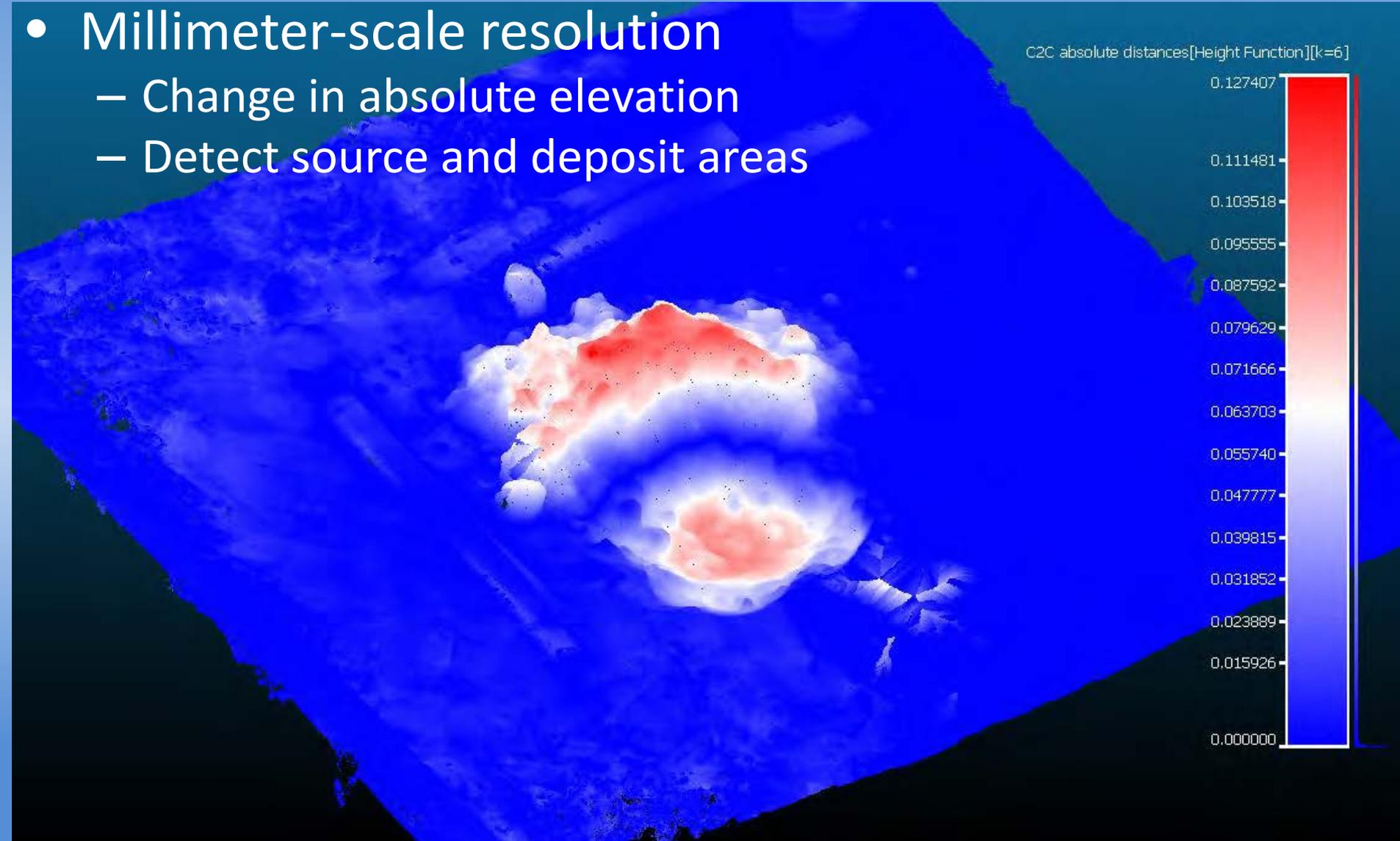


Surface change detection

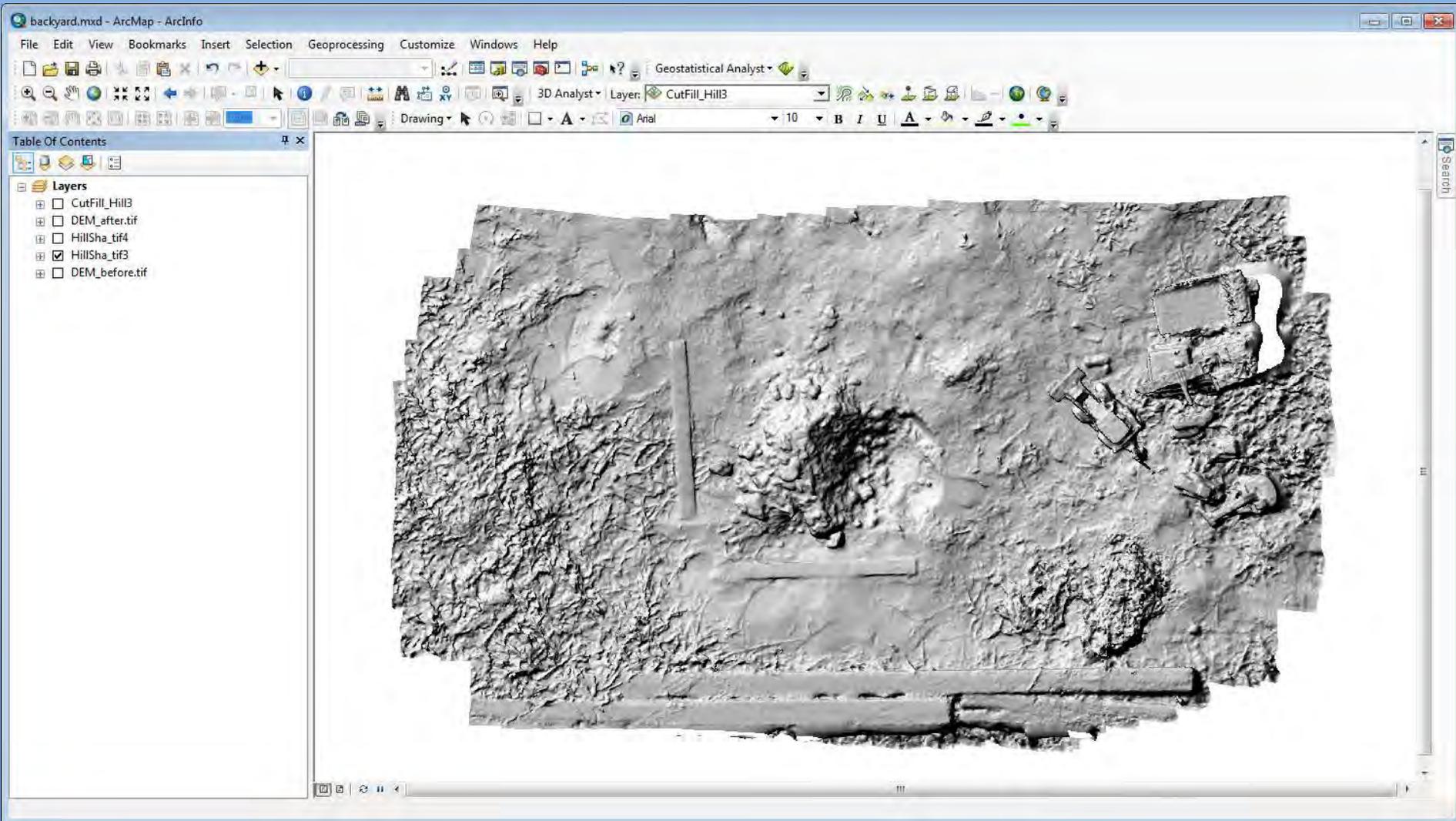
- Millimeter-scale resolution
 - Change in absolute elevation
 - Detect source and deposit areas

C2C absolute distances[Height Function][k=6]

0.127407
0.111481
0.103518
0.095555
0.087592
0.079629
0.071666
0.063703
0.055740
0.047777
0.039815
0.031852
0.023889
0.015926
0.000000



Surface change detection



Agisoft's Photoscan for photogrammetry

- **Cost effective**

- TLS systems* - \$60k - \$150k (new)
 - Difficult to transport
 - Annual maintenance (calibration)
- PhotoScan - ~\$10k
 - Computer+ software + camera
 - low annual costs for maintenance
 - Easy to transport
- Can be combined too⁺

- **Broadly applicable to Remote Sensing and can improve understanding and research for**

- *Geologic processes*
- *Anthropogenic changes*
- *Land-use monitoring (inside and adjacent to NPS units)*

*<http://www.sparpointgroup.com/Classifieds-Listing.aspx>

⁺ Bistacchi, A., et al (2011) Fault Roughness at Seismogenic Depths from LIDAR and Photogrammetric Analysis

Questions?

John Wood <john_wood@partner.nps.gov>