Accuracy and Error Assessment of Differing Techniques to Derive a Digital Terrain Model of Mt. St. Helens Crater

Wes Hoyer & Sarah Coffin

December 6th, 2012

Geography 593

Outline

- Research Goals
- Study Area
- Methods
- Results
- Discussion

Research Goals

- Create digital terrain models (DTMs) from aerial photos of the Mt. St. Helens crater
- Perform accuracy assessment of photogrametrically created DTMs
- Compare to accuracy assessment of DTM created from LiDAR data
- Characterize issues facing production of DTMs using photogrammetric methods

Methods

Study Area

Photo set comparison

2004

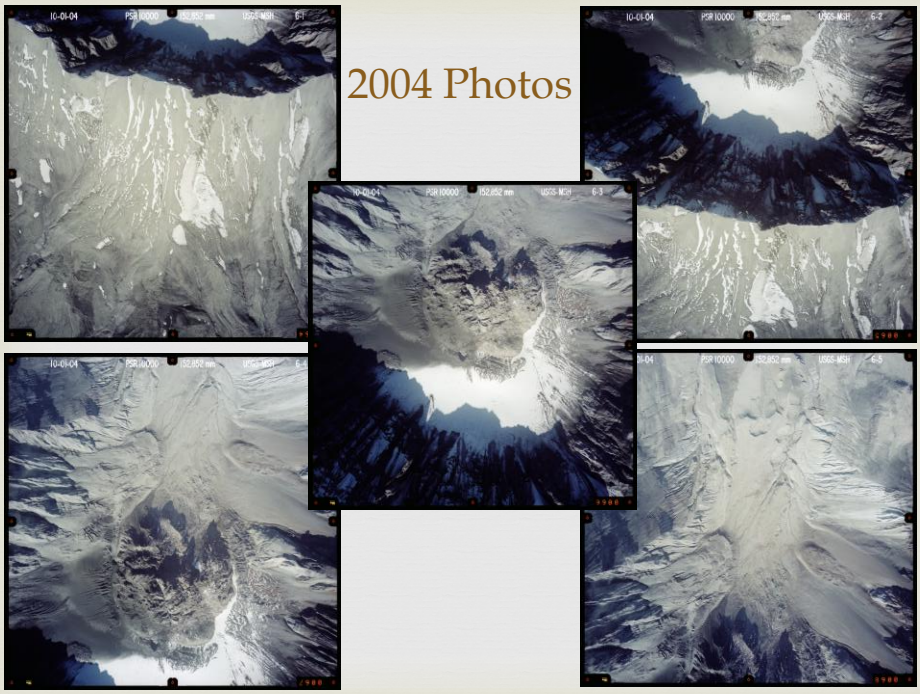
- Drum scanned at 12 micron (2000 dpi)
- Scale approx. 1:6000
- Taken prior to renewed lava dome activity
- Contains a pocket of snow

Photo Source: www.drumscan.com

2006

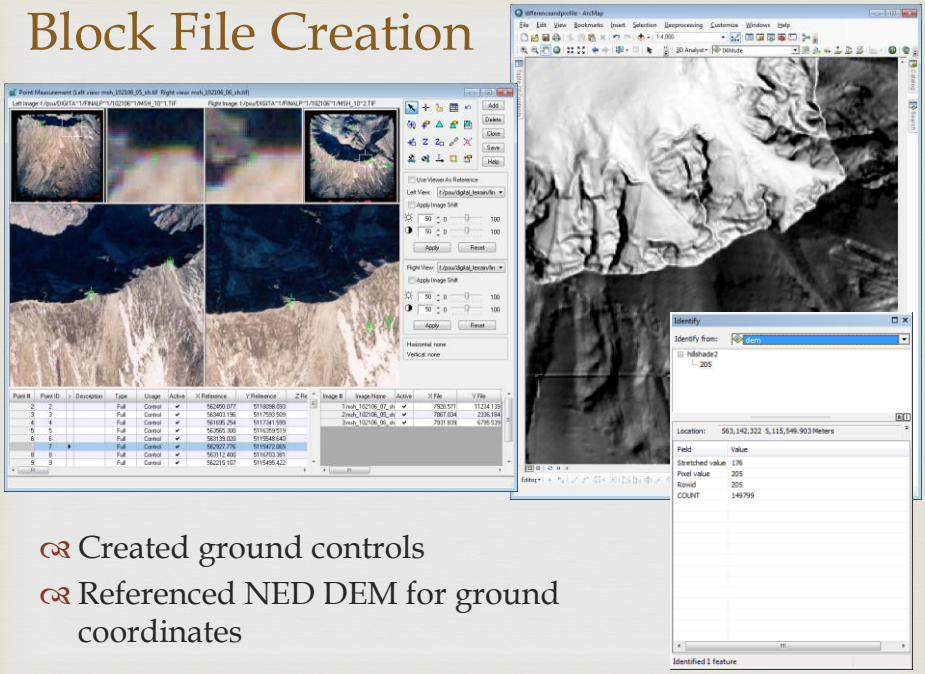
- Flatbed scanned at 20 micron (1200 dpi)
- Scale approx. 1:10,000
- Taken during period of lava dome activity
- Relatively snow free

2004 Photos



2006 Photos

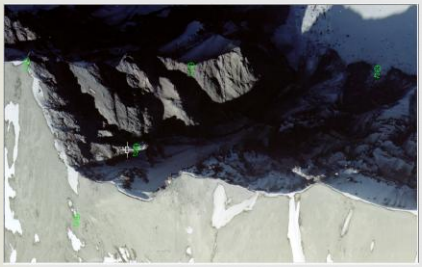
Block File Creation

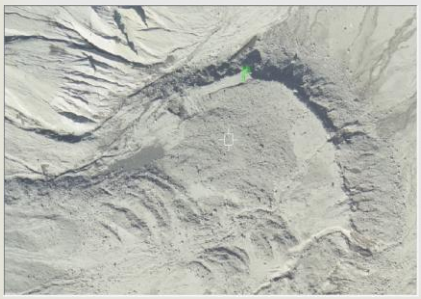


- Created ground controls
- Referenced NED DEM for ground coordinates

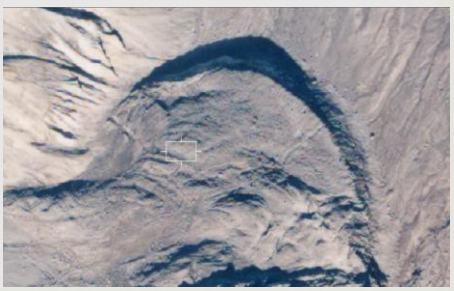
Image Resolution

2004

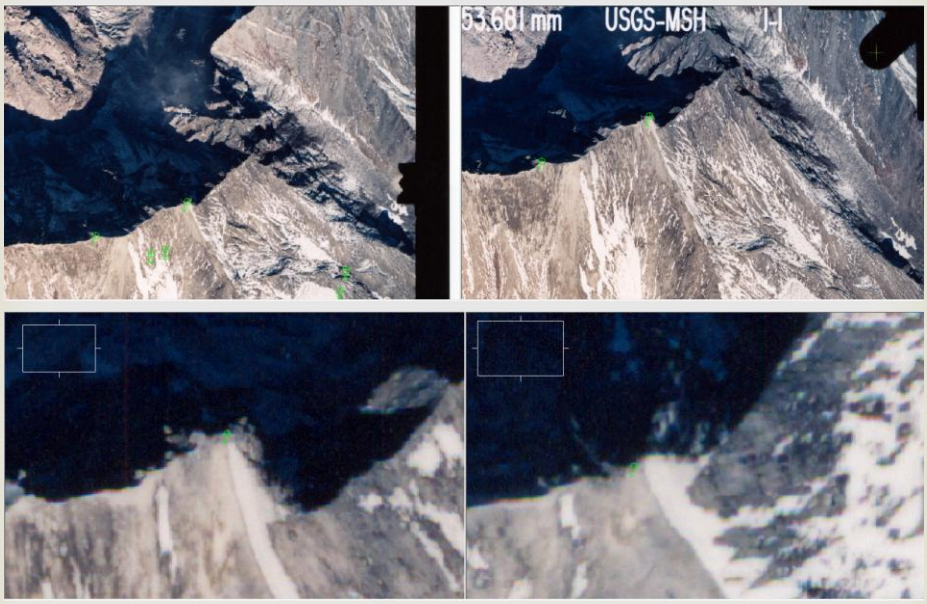




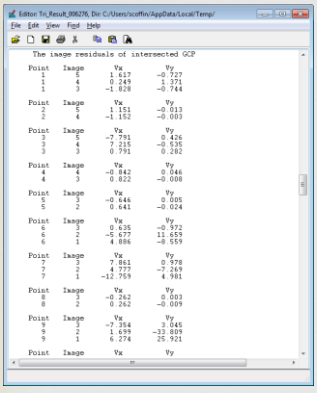
2006

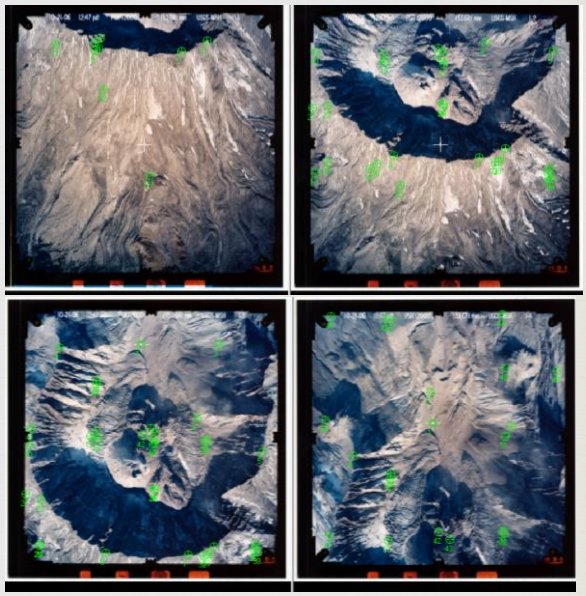


Relief Displacement



Tie Points and Triangulation





- Deleted tie points with highest RMSE
- Deleted points shared on more than two images

Results

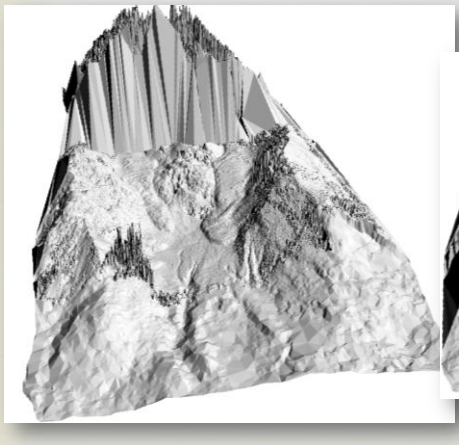
2004 DEM Hillshades

Higher RMSE

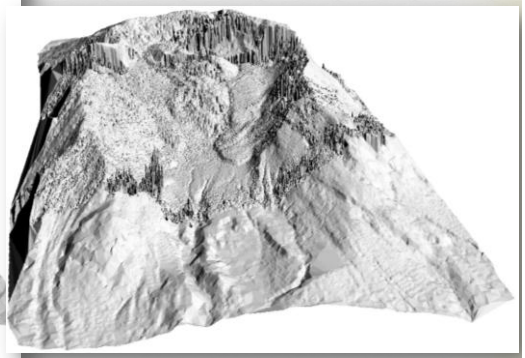
Lower RMSE

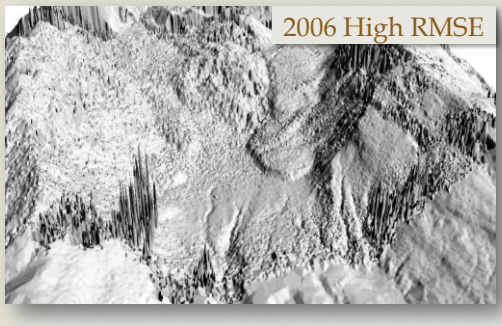
2006 DEM Hillshades

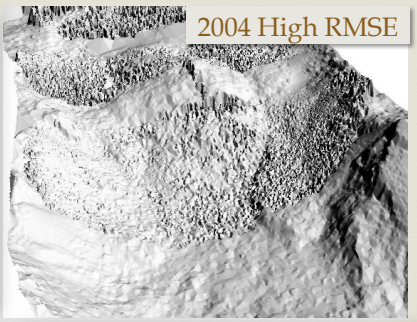
Lower RMSE

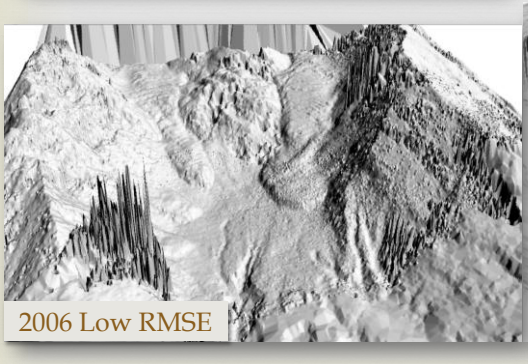


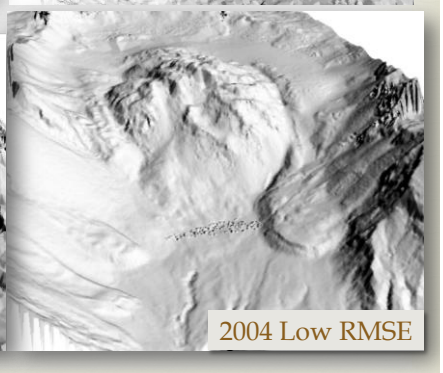
Higher RMSE



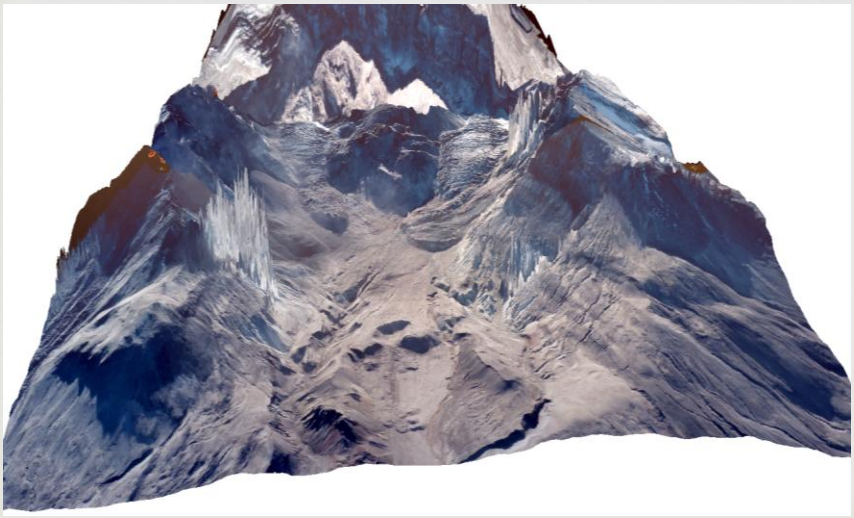




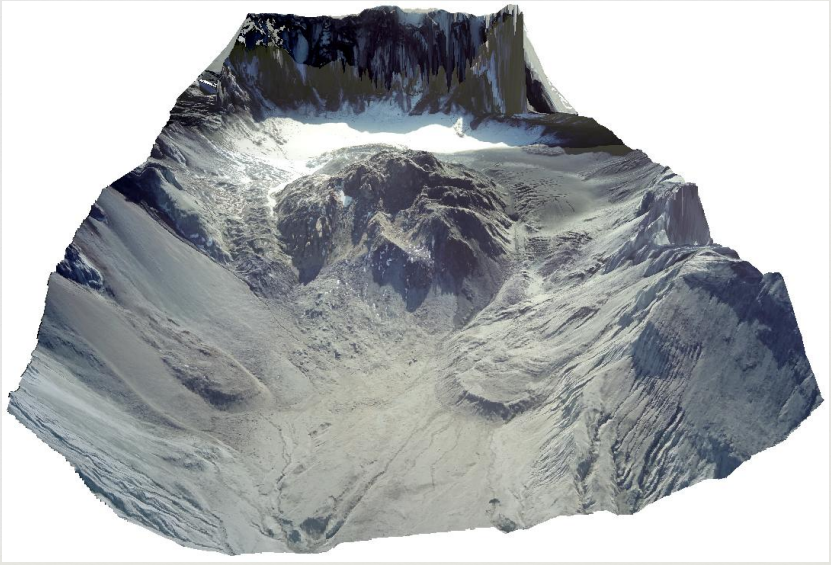




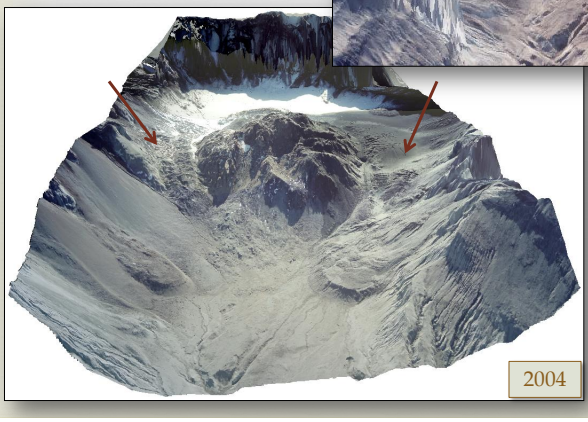
2006 Low RMSE Orthophoto



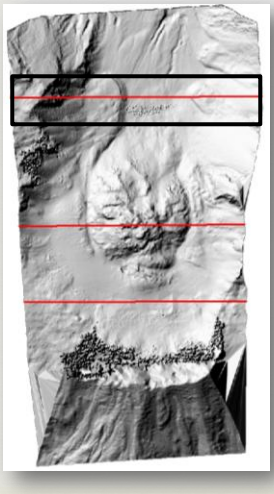
2004 Orthophoto

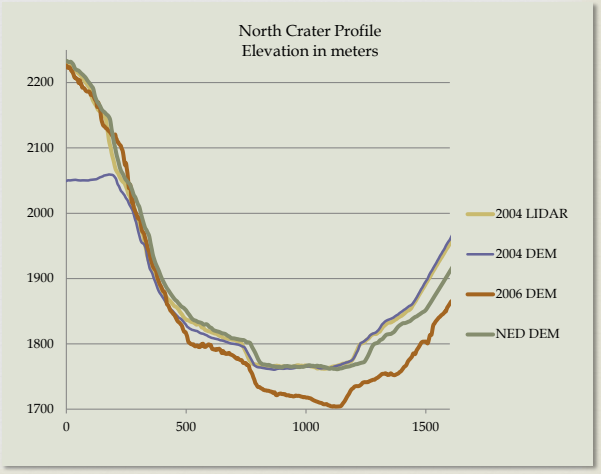


2004 Lava Dome Building Event

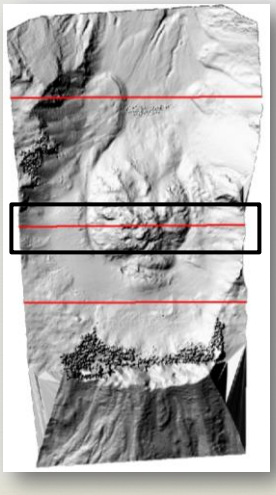


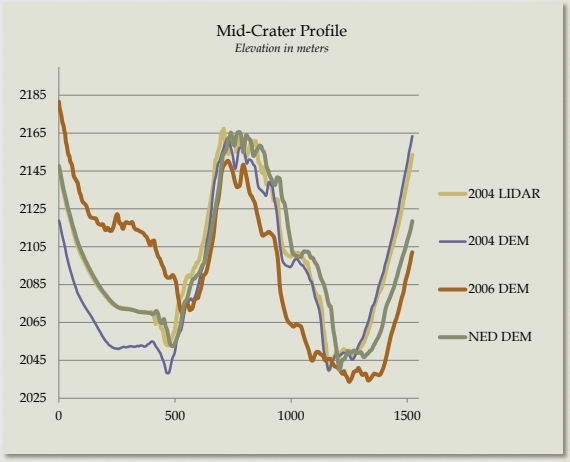
Profile Comparisons



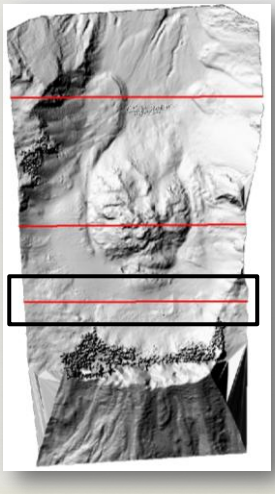


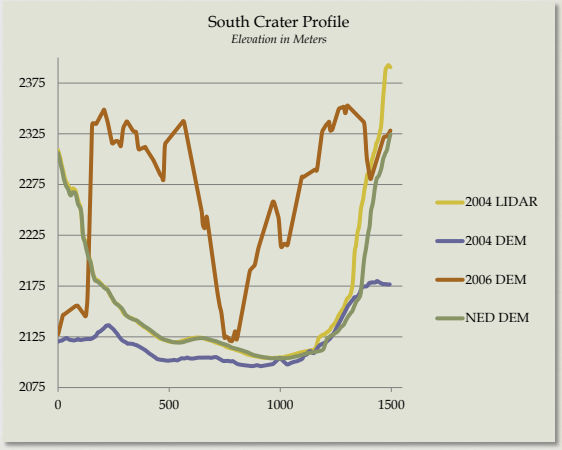
Profile Comparisons, cont.



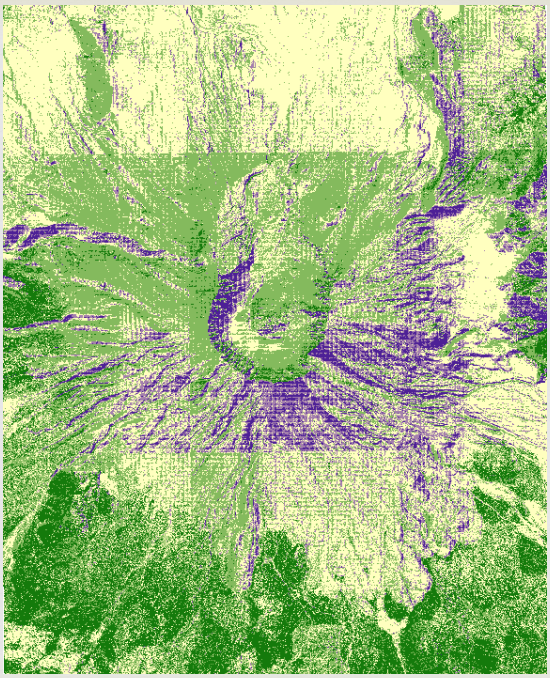


Profile Comparisons, cont.

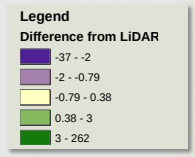




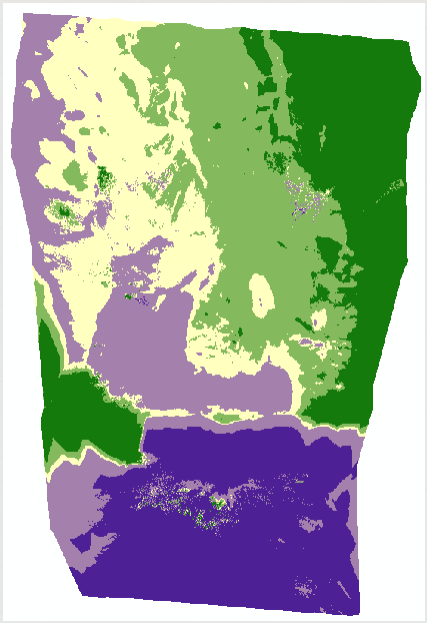
Difference DEMS



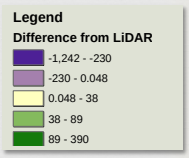
NED Difference DEM



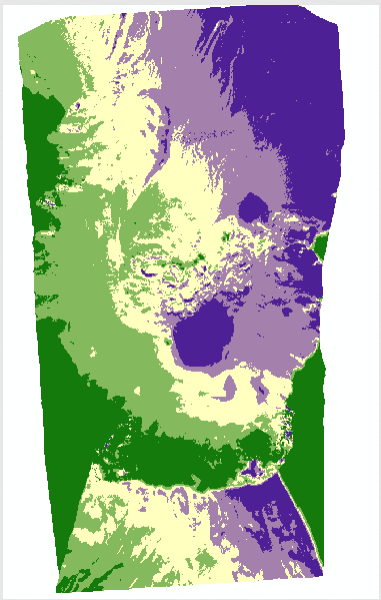
Difference DEMS



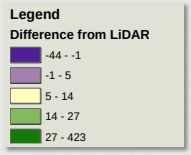
2006 Difference DEM



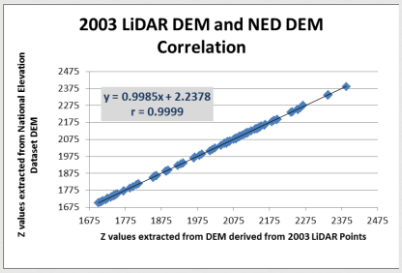
Difference DEMS

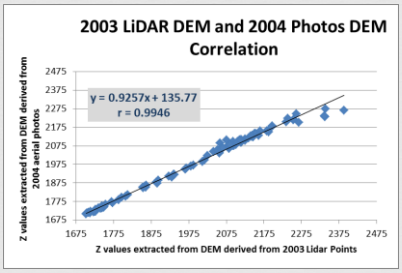


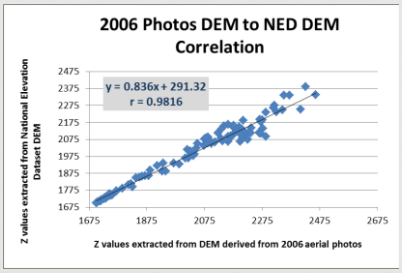
2004 Difference DEM

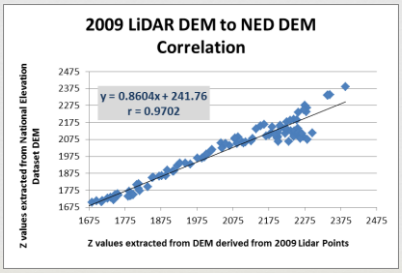


Correlations









Limitations

- Lack of accurate ground control points
- High relief and shadowing
- Snow
- Reference DEM was from different year than source photos
- Image quality
  - Resolution
  - Color

Conclusion

- Succeeded at creating DTMs of Mt. St. Helens crater
- Anomalies and noise make surfaces useful for qualitative and visual analysis but not for quantitative analysis, i.e. estimating lava dome growth
- Creating quality DTMs requires a lot of time and money

References

Lee, C.Y., S.D. Jones, C.J. Bellman, L. Buxton. 2008. DEM Creation of a Snow Covered Surface Using Digital Aerial Photography. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B8. Beijing. URL: http://www.isprs.org/proceedings/XXXVII/congress/8_pdf/8_WG-VIII-8/05.pdf Downloaded: 12-1-2012

Shomler, B. 2001. 30-bit and 36-bit vs 24-bit scanners: Will 30-bit and 36-bit Scanners Give Vetter Scanned Images? http://www.shomler.com/30bit.htm last accessed 12-5-2012

Toz, G. and M. Erdogan. DEM (Digital Elevation Model) Production and Accuracy Modeling of DEMs from 1:35,000 Scale Aerial Photographs. 2008. DEM Creation of a Snow Covered Surface Using Digital Aerial Photography. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B1. Beijing. URL: http://www.isprs.org/proceedings/XXXVII/congress/1_pdf/133.pdf Downloaded: 12-1-2012

Zukowskyj, P., R. Teeuw, and O. Munro. 2000. Interpolated Digital Elevation Model, Differential Global Positioning System Surveys and Digital Photgrammetry: A Quantitative Comparison of Accuracy from a Geomorphological Perspective. Fifth International Conference on GeoComputation. University of Greenwich, Kent, UK http://www.geocomputation.org/2000/GC002/Gc002.htm (last accessed 12-4-2012)

http://www.boston.com/bigpicture/2010/05/mount_st_helens_30_years_ago.html