

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



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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 photogrammetrically created DTMs
- ❧ Compare to accuracy assessment of DTM created from LiDAR data
- ❧ Characterize issues facing production of DTMs using photogrammetric methods

Methods



Study Area

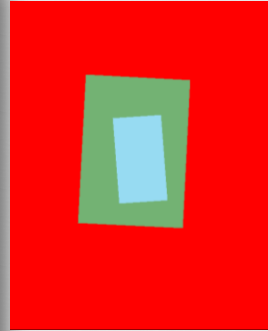
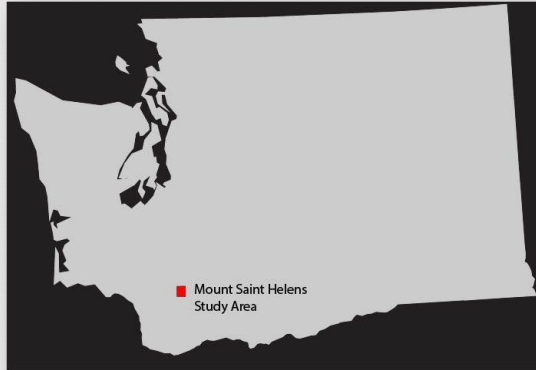


Photo set comparison



2004

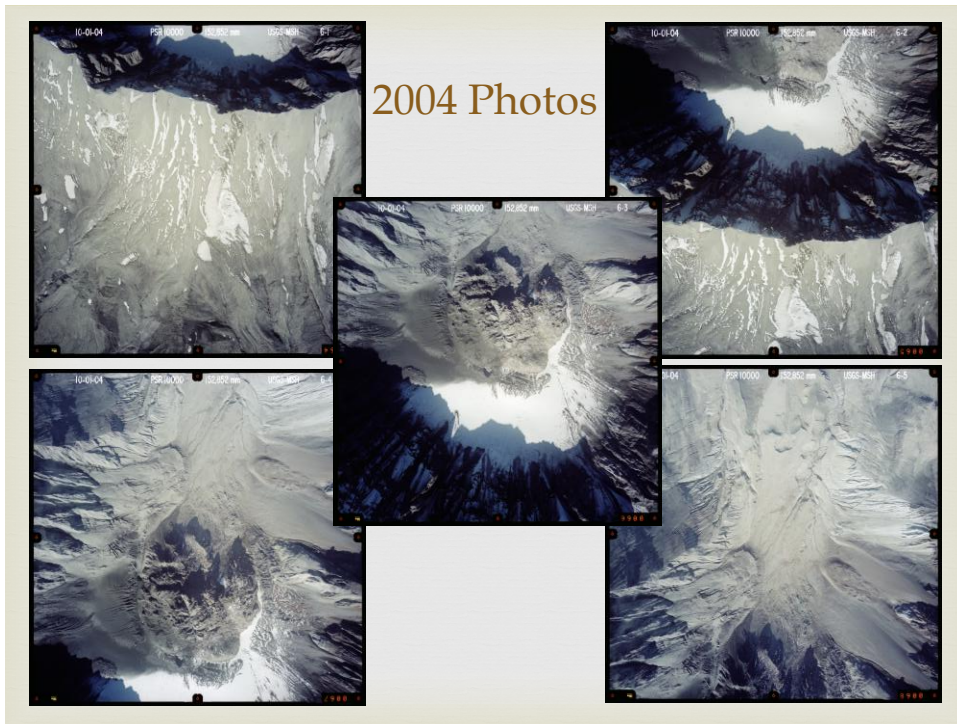
- ❧ Drum scanned at 12 micron (2000 dpi)
- ❧ Scale approx. 1:6000
- ❧ Taken prior to renewed lava dome activity
- ❧ Contains a pocket of snow



Photo Source: www.drumsan.com

2006

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



Block File Creation

Point Measurement (Left view: mesh_202206_25_01.tif, Right view: mesh_202206_25_01.tif)

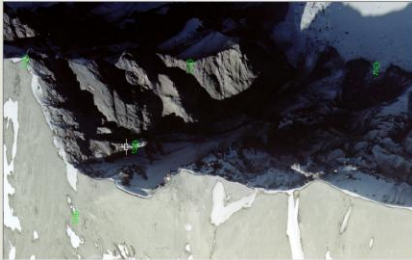
Point ID	Description	Type	Usage	Active	X Reference	Y Reference	Z Ref	Image ID	Image Name	Active	X Ref	Y Ref
1	Full	Control	✓		563000.000	5115000.000		1	mesh_202206_25_01.tif	✓	563000.000	5115000.000
2	Full	Control	✓		563000.000	5115000.000		2	mesh_202206_25_01.tif	✓	563000.000	5115000.000
3	Full	Control	✓		563000.000	5115000.000		3	mesh_202206_25_01.tif	✓	563000.000	5115000.000
4	Full	Control	✓		563000.000	5115000.000		4	mesh_202206_25_01.tif	✓	563000.000	5115000.000
5	Full	Control	✓		563000.000	5115000.000		5	mesh_202206_25_01.tif	✓	563000.000	5115000.000
6	Full	Control	✓		563000.000	5115000.000		6	mesh_202206_25_01.tif	✓	563000.000	5115000.000
7	Full	Control	✓		563000.000	5115000.000		7	mesh_202206_25_01.tif	✓	563000.000	5115000.000
8	Full	Control	✓		563000.000	5115000.000		8	mesh_202206_25_01.tif	✓	563000.000	5115000.000
9	Full	Control	✓		563000.000	5115000.000		9	mesh_202206_25_01.tif	✓	563000.000	5115000.000

Identify from: Inflate2
Pixel value: 205
Location: 563,142,322 5,115,546,903 Meters
Field value: 176
Pixel value: 205
COUNT: 146799

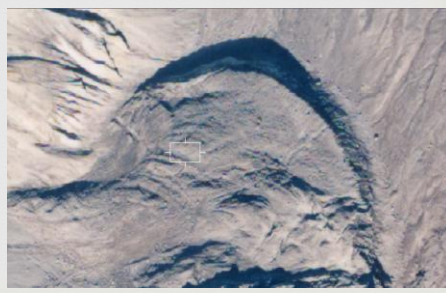
Created ground controls
Referenced NED DEM for ground coordinates

Image Resolution

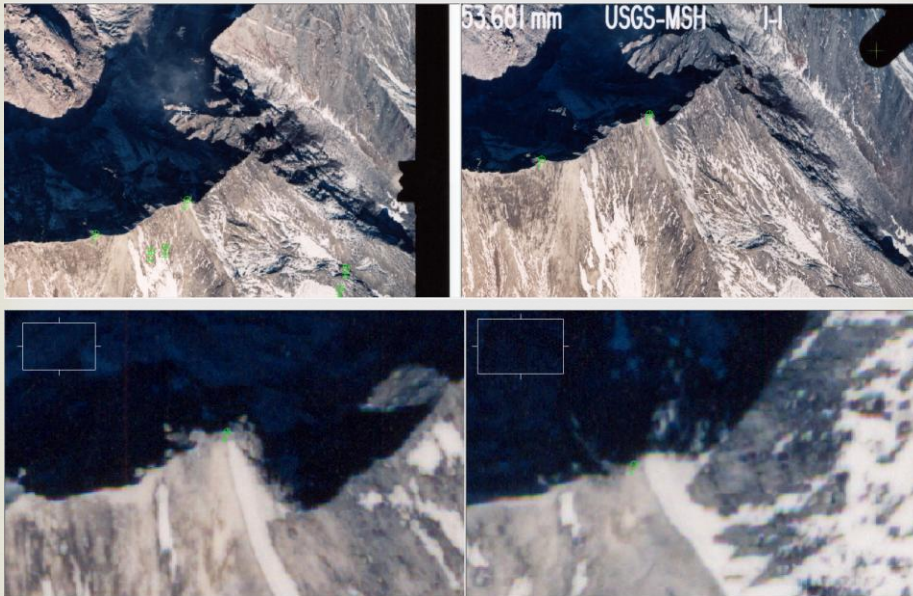
2004



2006



Relief Displacement



Tie Points and Triangulation

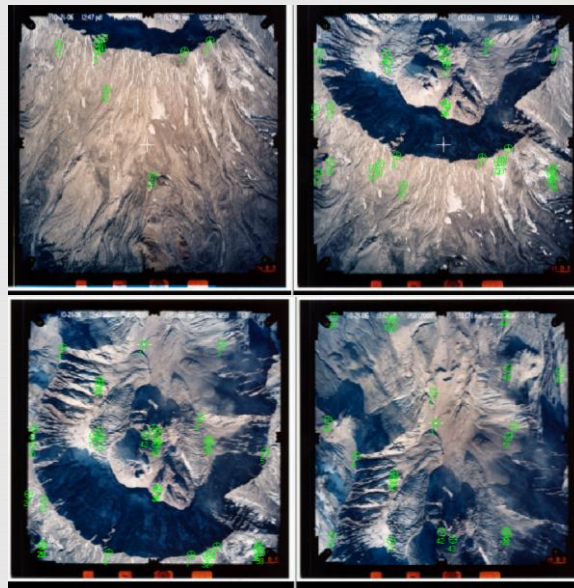
Editor: Nt_Renak_200707, Dir: C:\Users\scuffin\AppData\Local\Temp\

File Edit View Help

The image residuals of intersected GCP

Point	Image	Vx	Vy
Point 1	Image 1	1.517	-0.127
4	0.249	1.371	
3	-0.028	-0.144	
Point 2	Image 1	1.151	-0.033
4	-0.152	-0.093	
Point 3	Image 1	-0.779	0.426
4	7.235	-0.535	
3	0.791	0.282	
Point 4	Image 1	-0.842	0.046
4	3	0.622	-0.008
Point 5	Image 1	-0.646	0.505
5	2	0.641	-0.024
Point 6	Image 1	0.235	-0.572
6	2	-0.577	11.859
6	1	4.686	-0.559
Point 7	Image 1	7.541	0.778
7	2	4.777	-7.269
7	1	-17.769	4.981
Point 8	Image 1	-0.262	0.503
8	2	0.262	-0.009
Point 9	Image 1	-7.264	3.445
9	2	1.589	-11.859
9	1	0.274	25.921
Point	Image	Vx	Vy

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



Results

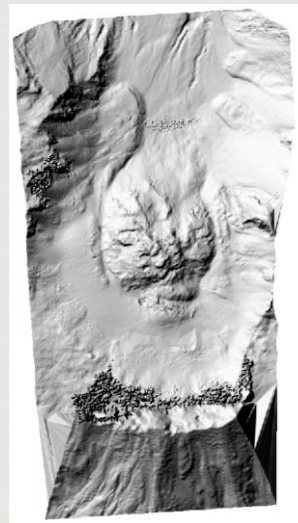


2004 DEM Hillshades

Higher RMSE

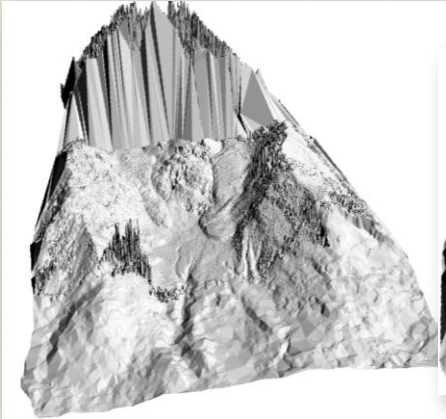


Lower RMSE

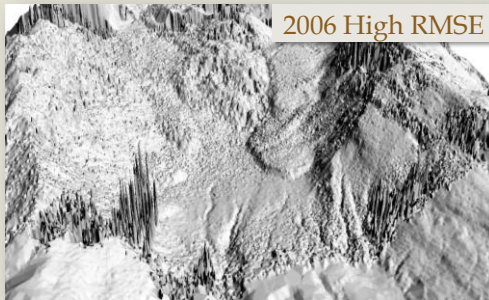
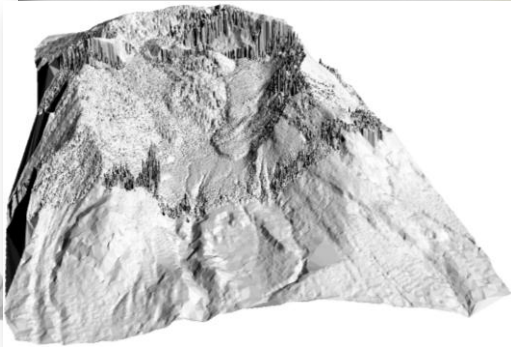


2006 DEM Hillshades

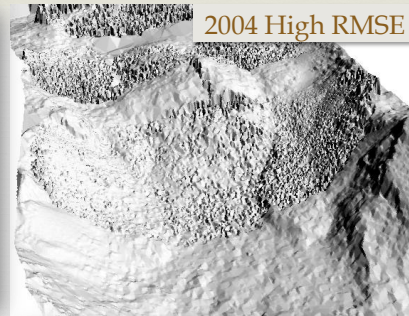
Lower RMSE



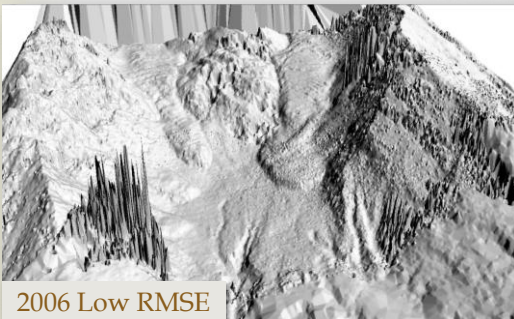
Higher RMSE



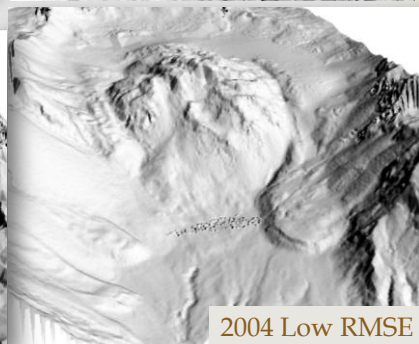
2006 High RMSE



2004 High RMSE

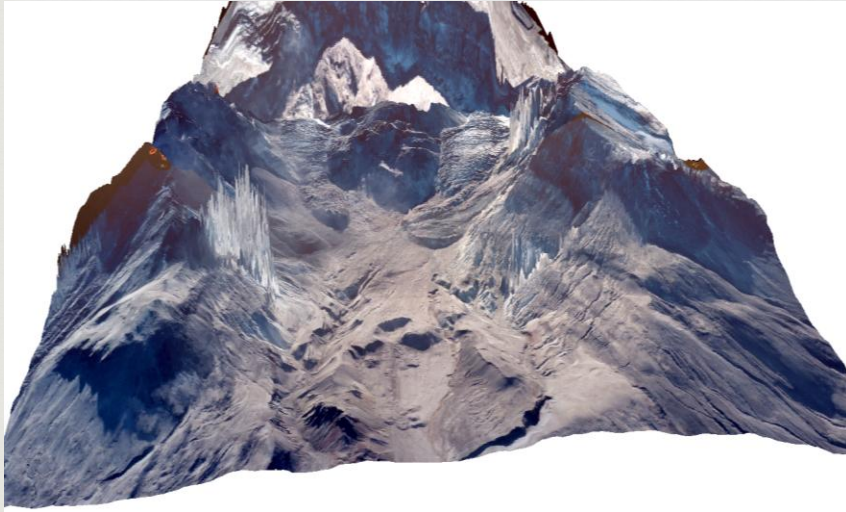


2006 Low RMSE

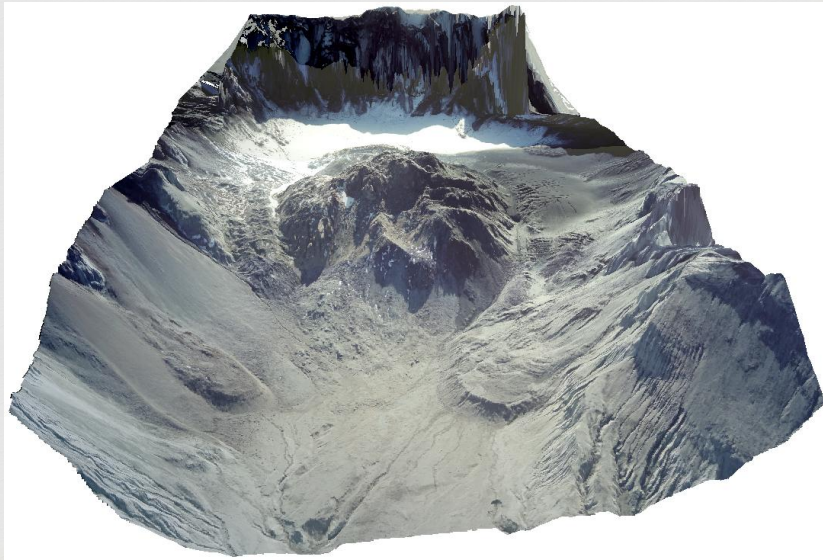


2004 Low RMSE

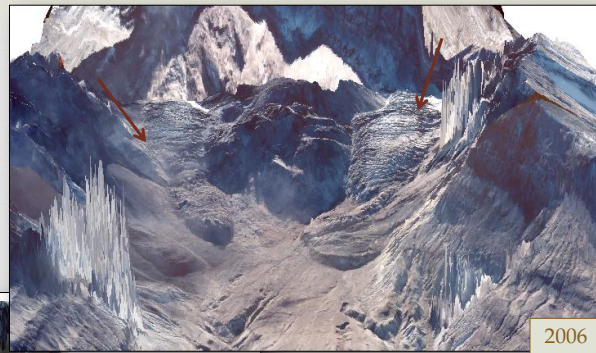
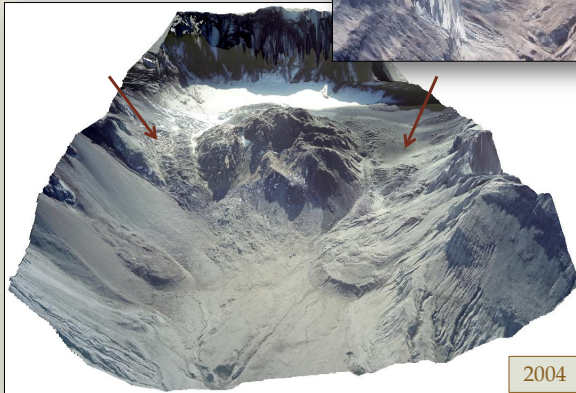
2006 Low RMSE Orthophoto



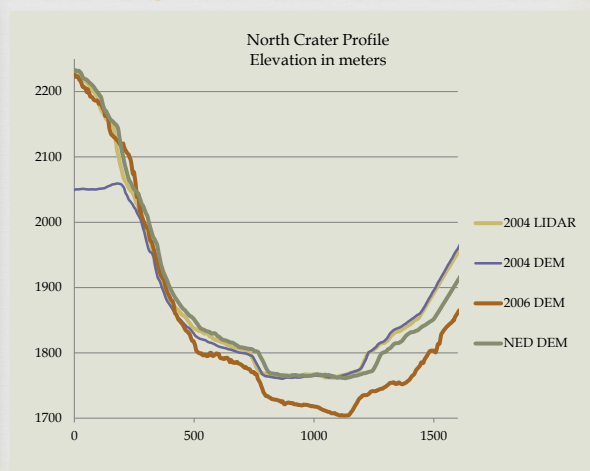
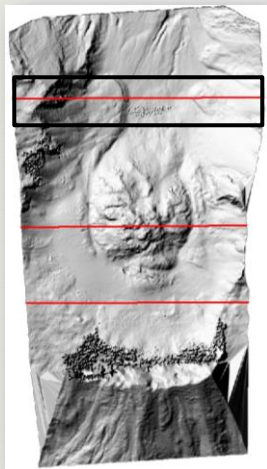
2004 Orthophoto



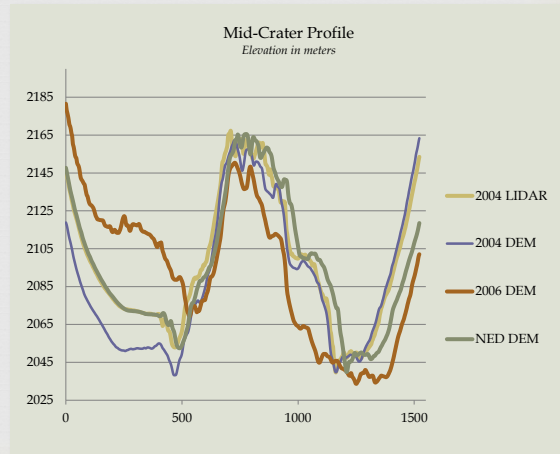
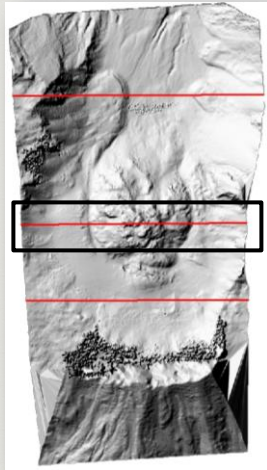
2004 Lava Dome Building Event



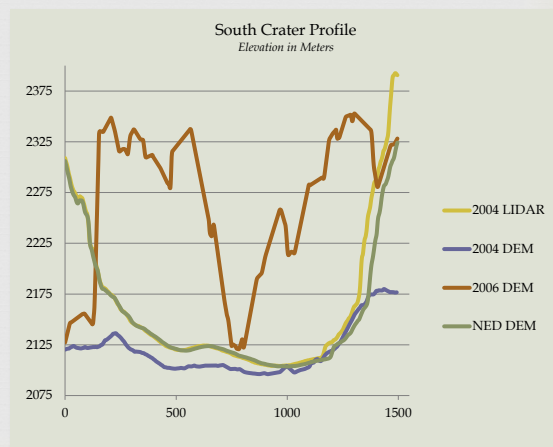
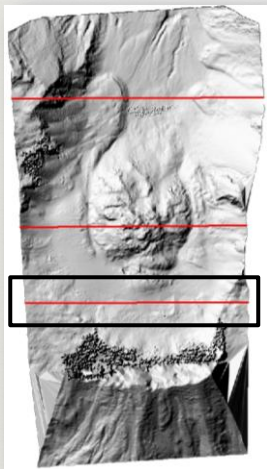
Profile Comparisons



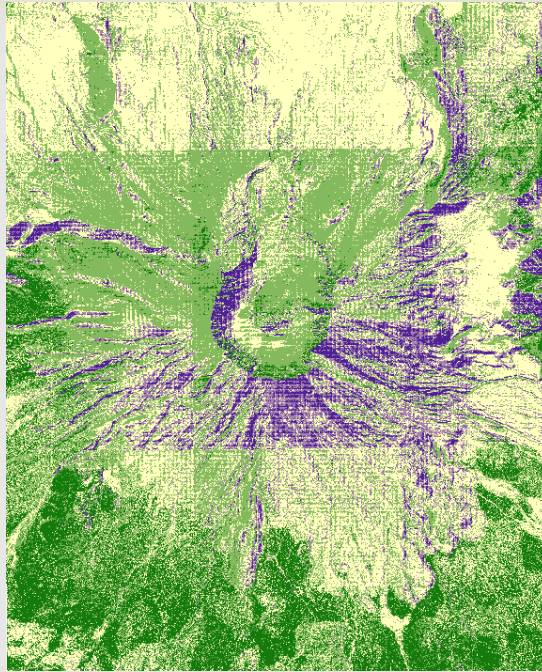
Profile Comparisons, cont.



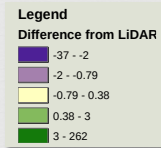
Profile Comparisons, cont.



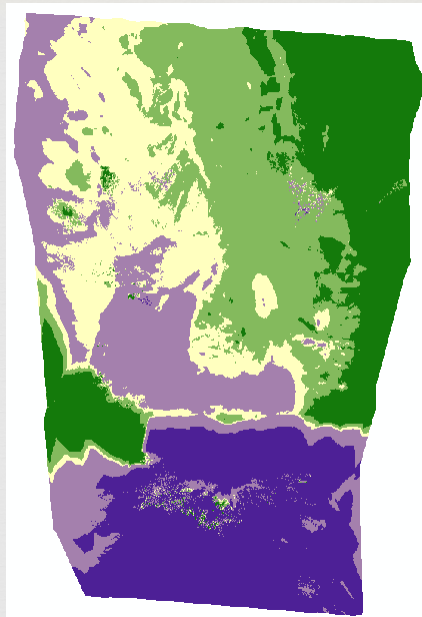
Difference DEMs



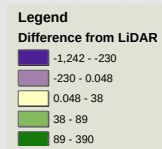
NED Difference DEM



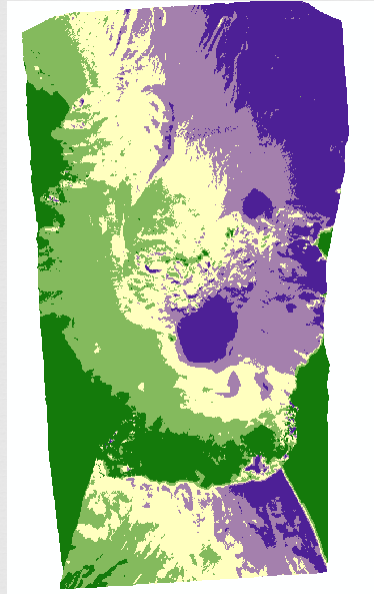
Difference DEMs



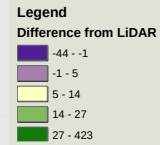
2006 Difference DEM



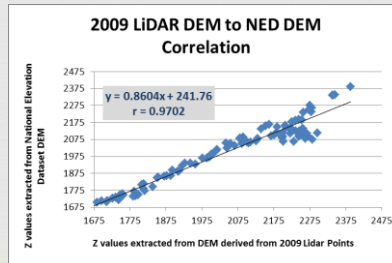
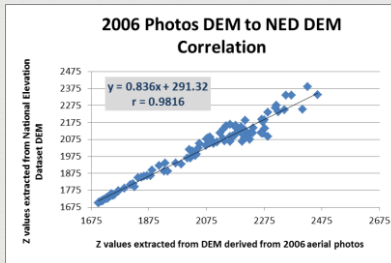
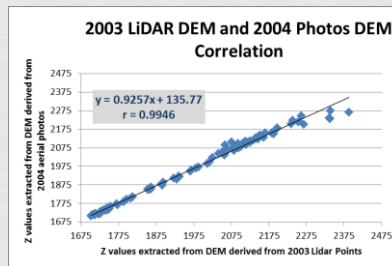
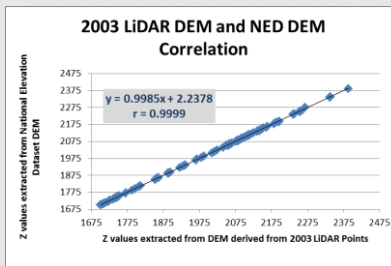
Difference DEMs



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

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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 Photogrammetry: 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)



Questions?

http://www.houston.com/bigpicture/2010/01/mount_st_helens_30_years_ago.html