PhotoScan For Planetary and Analog Sites

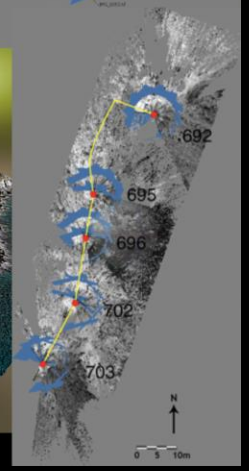
Wagner, Henriksen, Manheim, and Robinson

Arizona State University

231,383

Agisoft PhotoScan: Photogrammetry from arbitrary input images

- Archeology
- Film and TV
- Video games
- Aerial mapping
- MSL traverse mapping



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- Outputs:
  - Point cloud
  - Textured model
  - Digital Elevation Model
  - Orthophotos/mosaic
  - Camera models

- Price:
  - $550 for ed. institutes
  - $3500 otherwise

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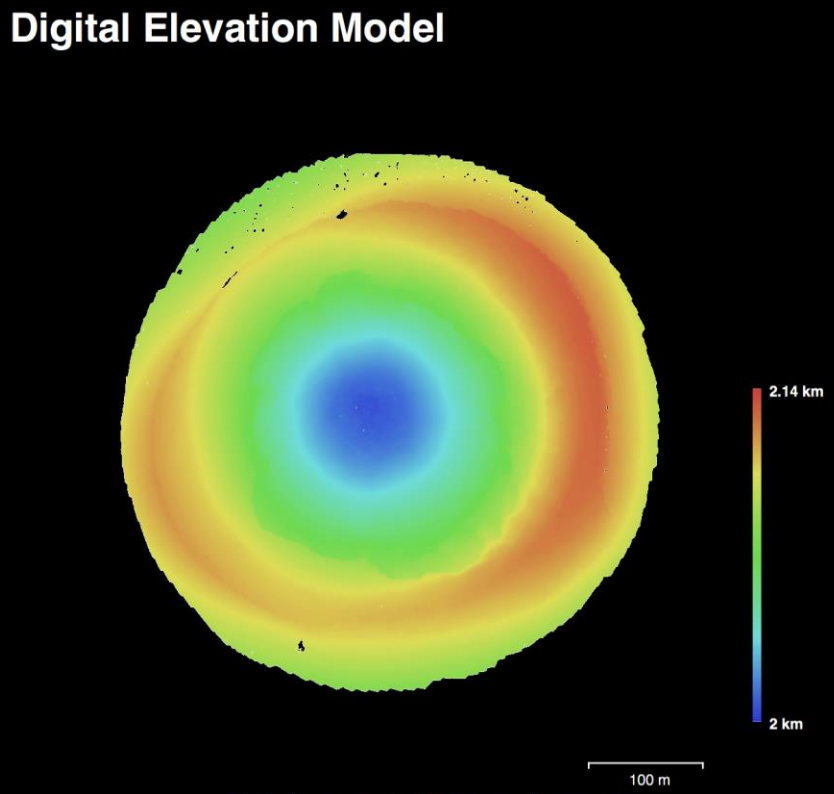

Fig. 7. Reconstructed digital elevation model.

Resolution:	12.4 cm/pix
Point density:	65.2 points/m²

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Camera Calibration

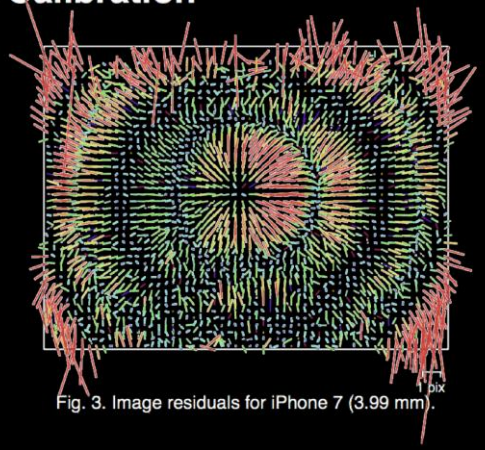

Fig. 3. Image residuals for iPhone 7 (3.99 mm).

iPhone 7 (3.99 mm)
103 images

Type	Resolution	Focal Length	Pixel Size
Frame	**4032 x 3024**	**3.99 mm**	**1.22 x 1.22 µm**

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	P1	P2
F	3292.69	0.24	1.00	0.00	0.04	-0.87	-0.06	-0.07	0.08	-0.05	-0.00	-0.08
Cx	-0.264584	0.16		1.00	-0.06	0.03	-0.05	-0.01	0.02	-0.02	0.97	-0.04
Cy	-35.0705	0.27			1.00	-0.31	-0.01	-0.04	0.06	-0.09	-0.04	0.86
B1	-0.447404	0.22				1.00	0.07	-0.04	0.03	-0.03	0.02	-0.08
B2	-0.327688	0.12					1.00	0.01	-0.01	0.01	-0.13	0.03
K1	0.153263	0.00025						1.00	-0.97	0.92	-0.01	-0.00
K2	-0.672023	0.0013							1.00	-0.99	0.02	0.03
K3	0.986438	0.0022								1.00	-0.02	-0.06
P1	0.000778086	1.9e-05									1.00	-0.03
P2	0.000570537	2.2e-05										1.00

Table 3. Calibration coefficients and correlation matrix.

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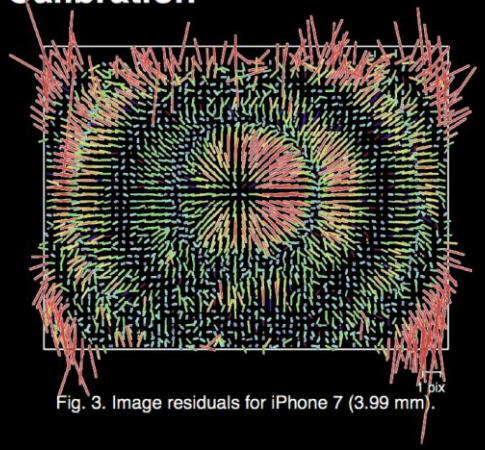

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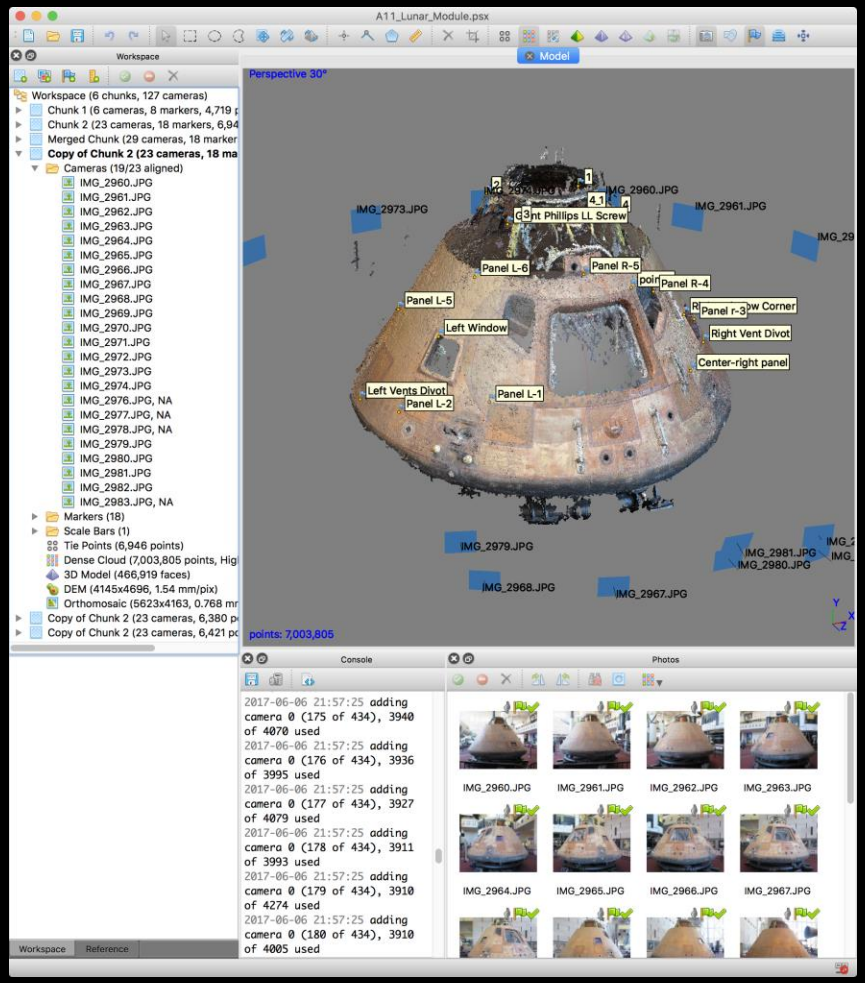
- [Mask images]
- [Add reference markers]
- [Add tie points if needed]
- Optimize alignment
- Build dense point cloud
- Build other products



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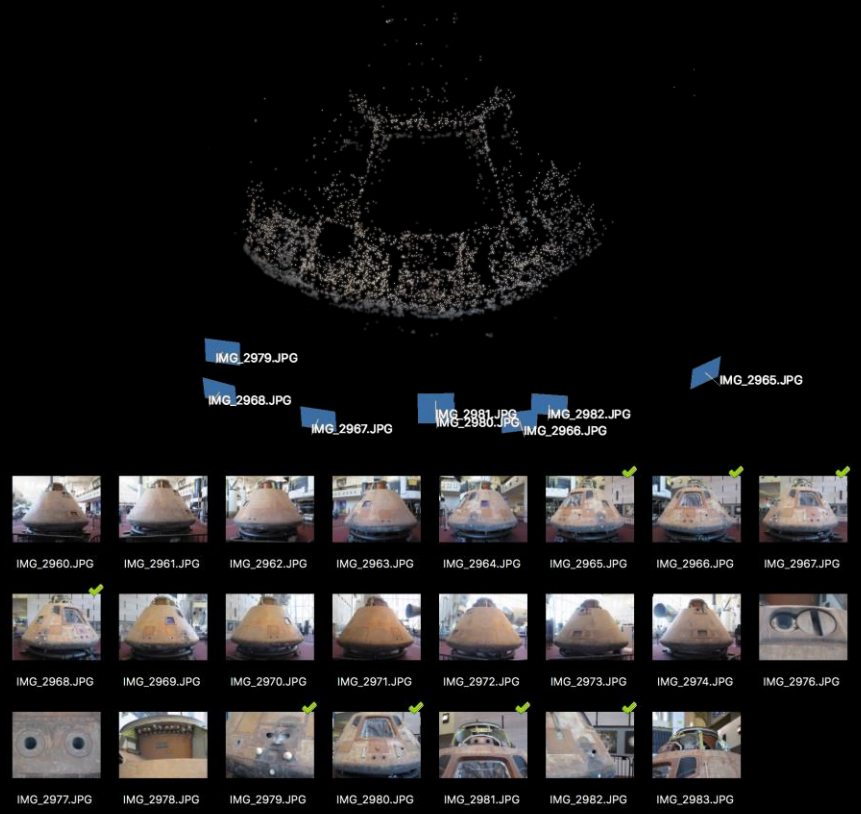

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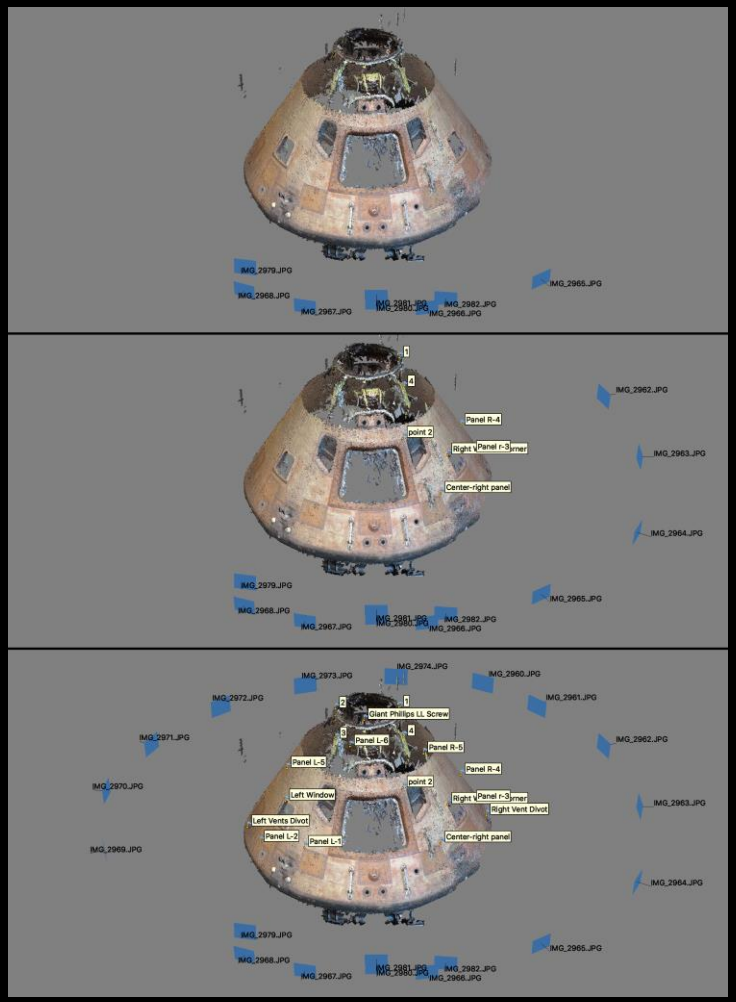

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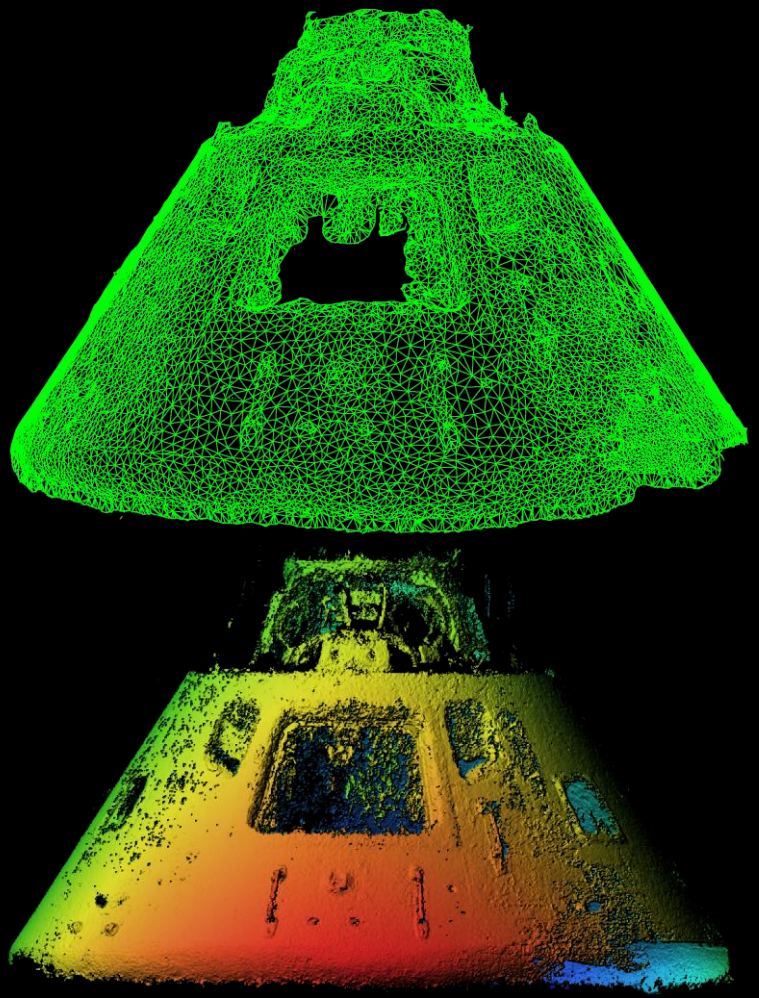

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Planetary and Analogue Test Sites

- Building courtyard
  - Smartphones + calibration targets
- Shorty Crater trench (Apollo 17)
  - Hasselblad camera + gnomon
- SP Crater cinder cone
  - Smartphones, handheld digital cameras, drone

Courtyard Results

- ~20x20m interior courtyard of a building
- 48 images w/ iPhone 5s
- Produced DEM at 2.5 cm/px
- Fountain, table heights from DEM matched real world within 2cm
- Tilt issues…

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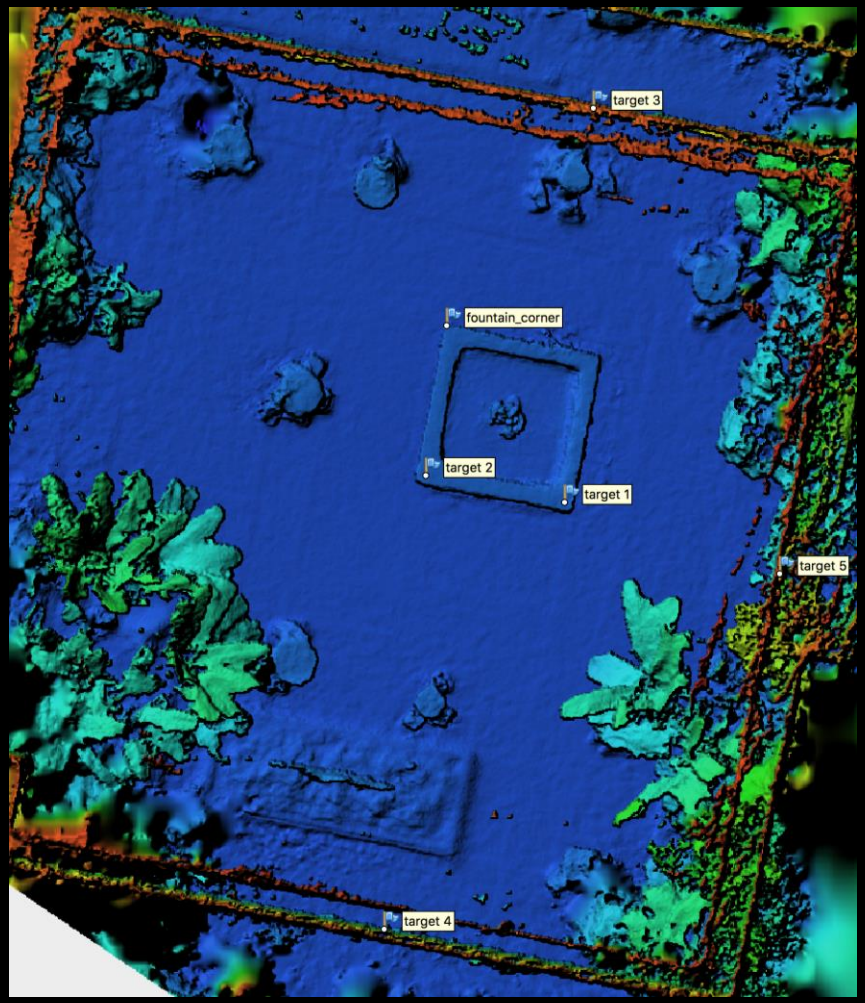

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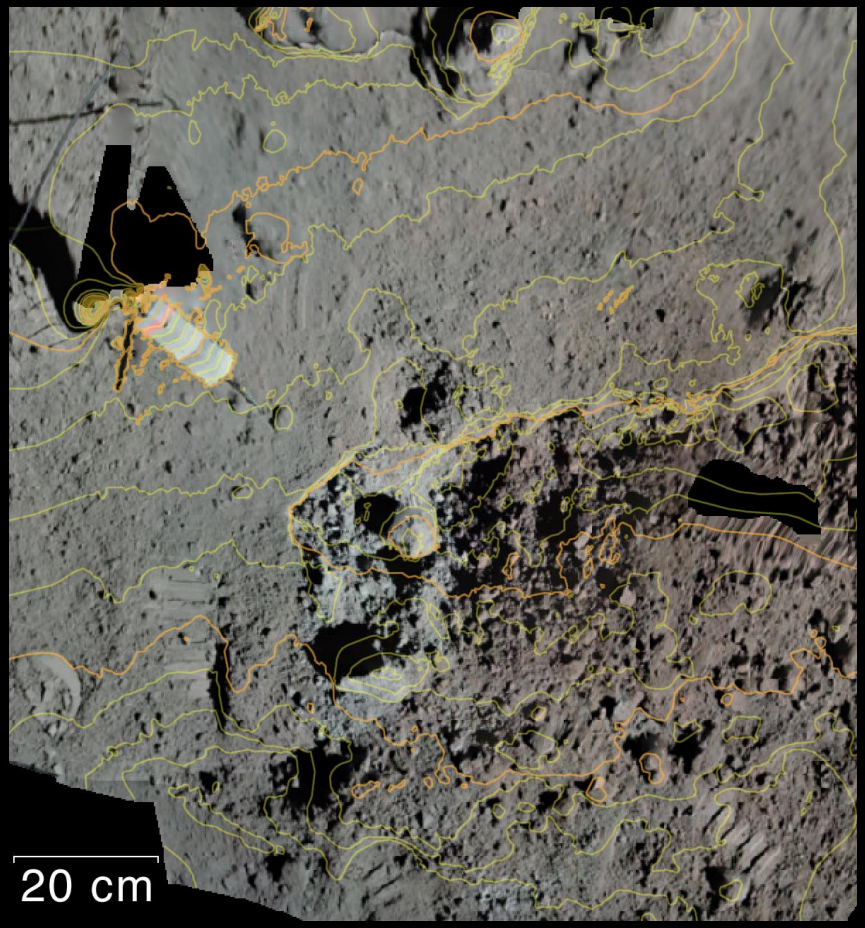
Apollo 17 Results

- ~1.2m long trench dug in the wall of Shorty Crater by Jack Schmitt
- 7 images, 1 camera
- Scale provided by Apollo gnomon
- Produced DEM at 0.9 cm/px



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SP Crater Results

- Cindercone with ~400m wide caldera
- 434 images, 3 cameras
- Produced DEM at 12.5 cm/px
- Elevations similar to USGS DEM, but higher quality and resolution

Google Maps

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PhotoScan Orthoimage

SP Crater Results

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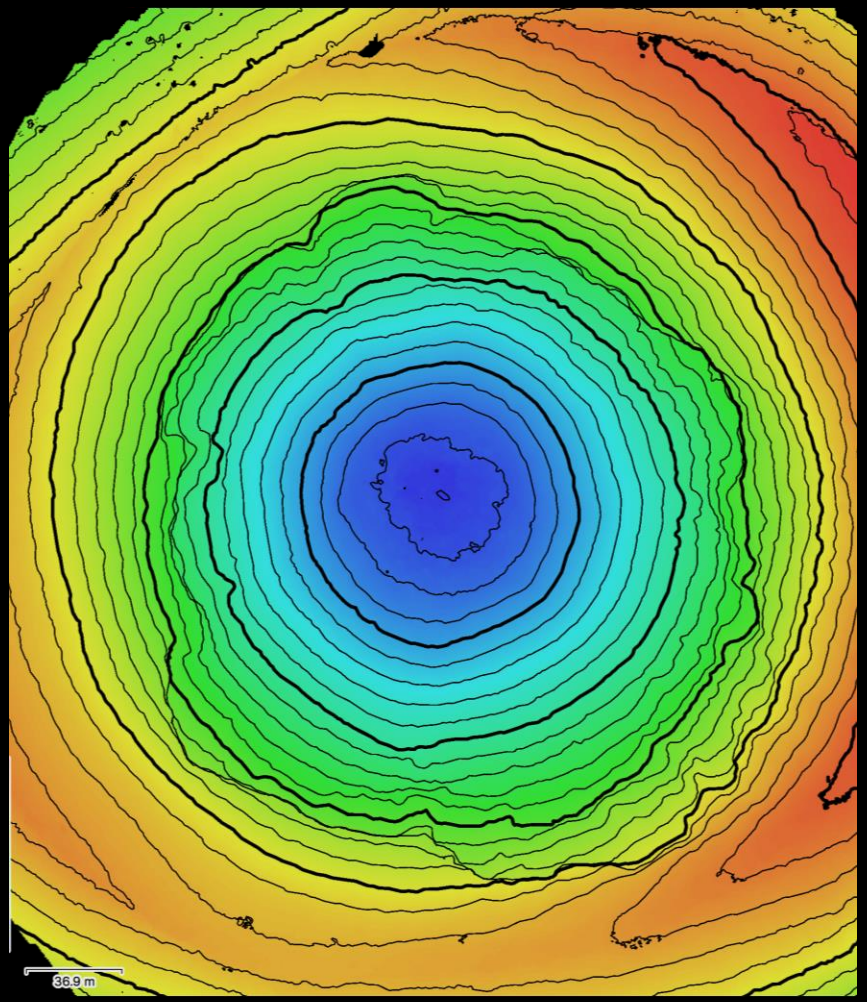
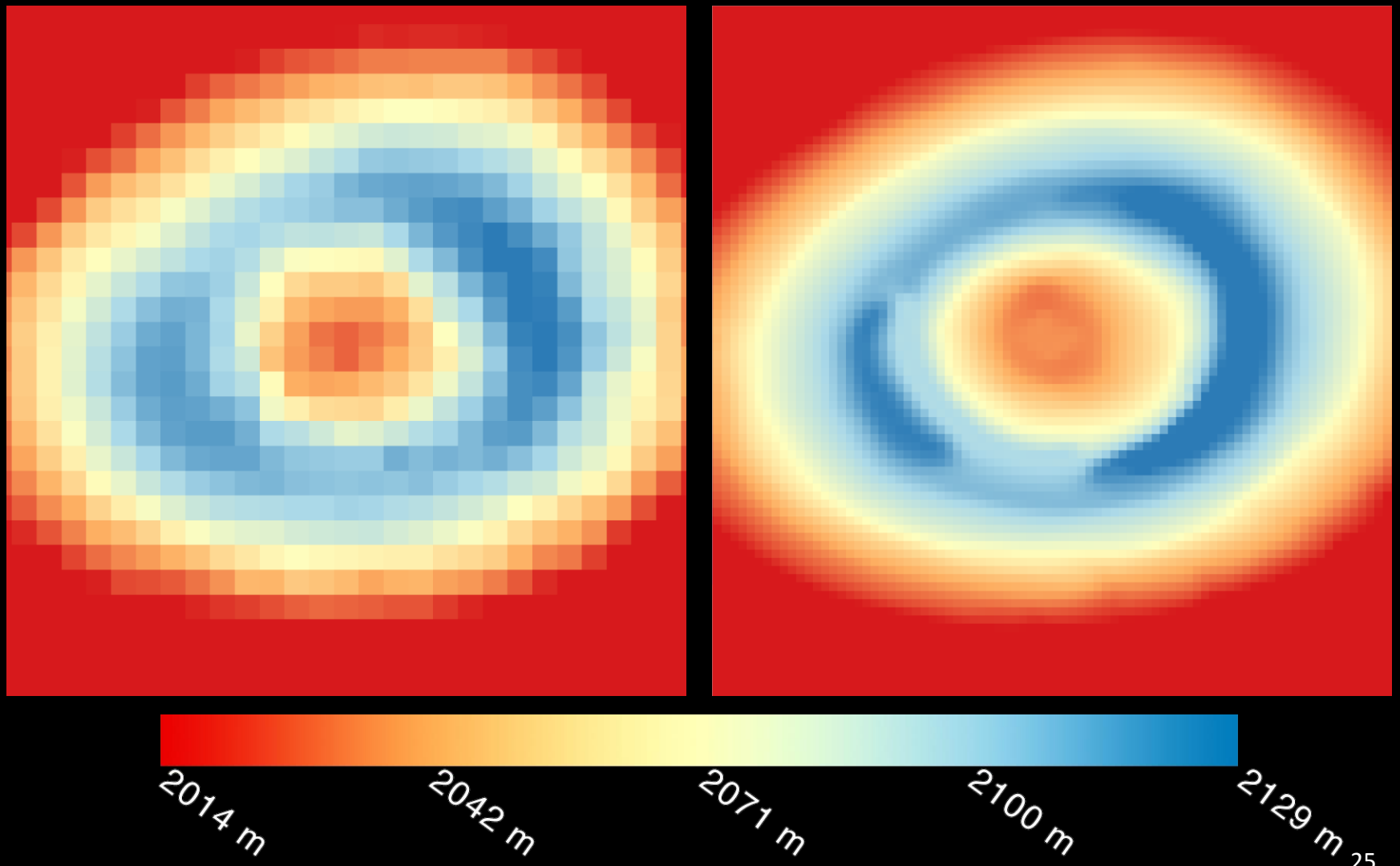
- Elevations similar to USGS DEM
  - We show peak 7 m below USGS topo map

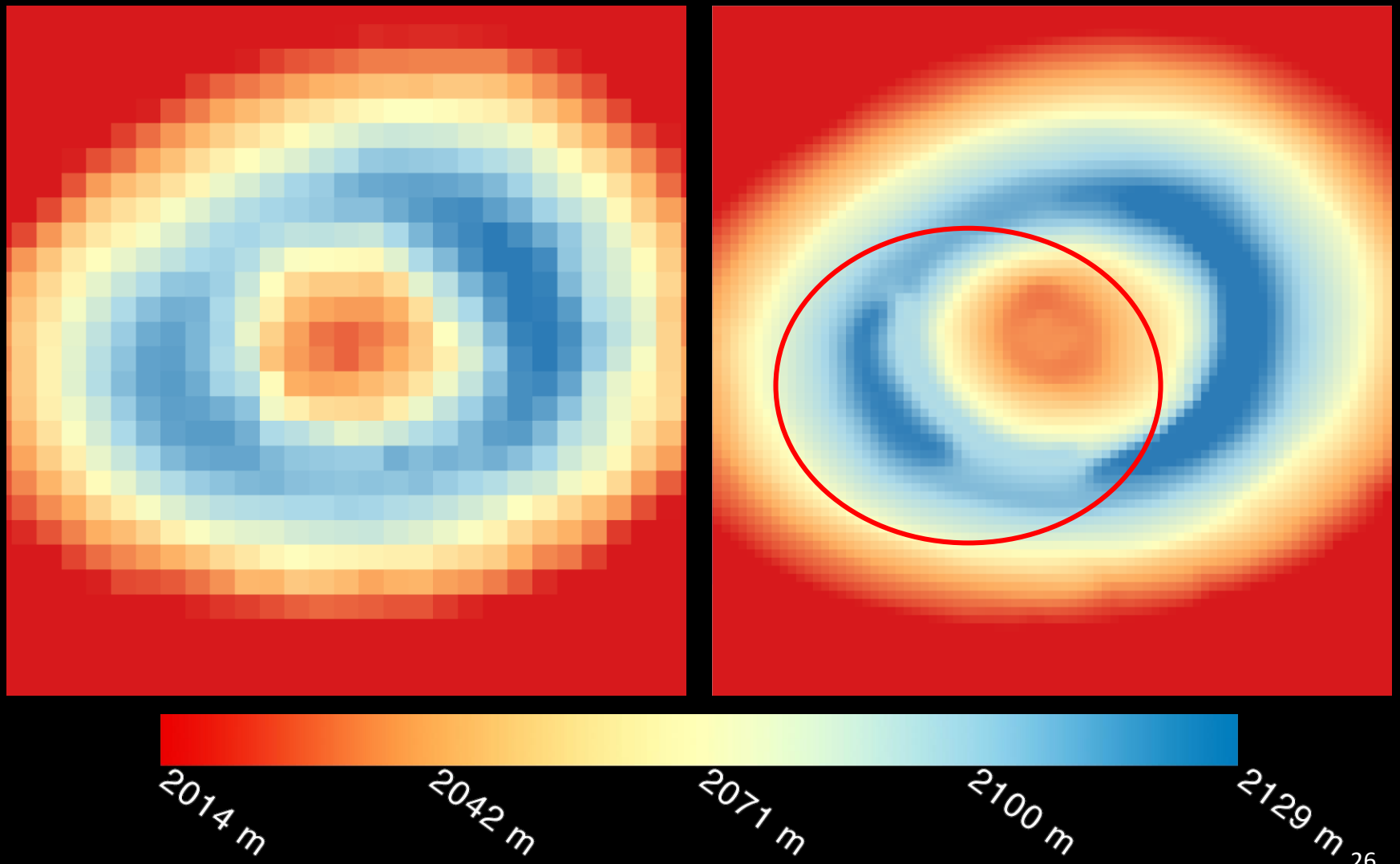


PhotoScan DEM

Two existing DEMs: Shuttle radar (30 m) and USGS (10 m)



USGS DEM seems to have artifacts…



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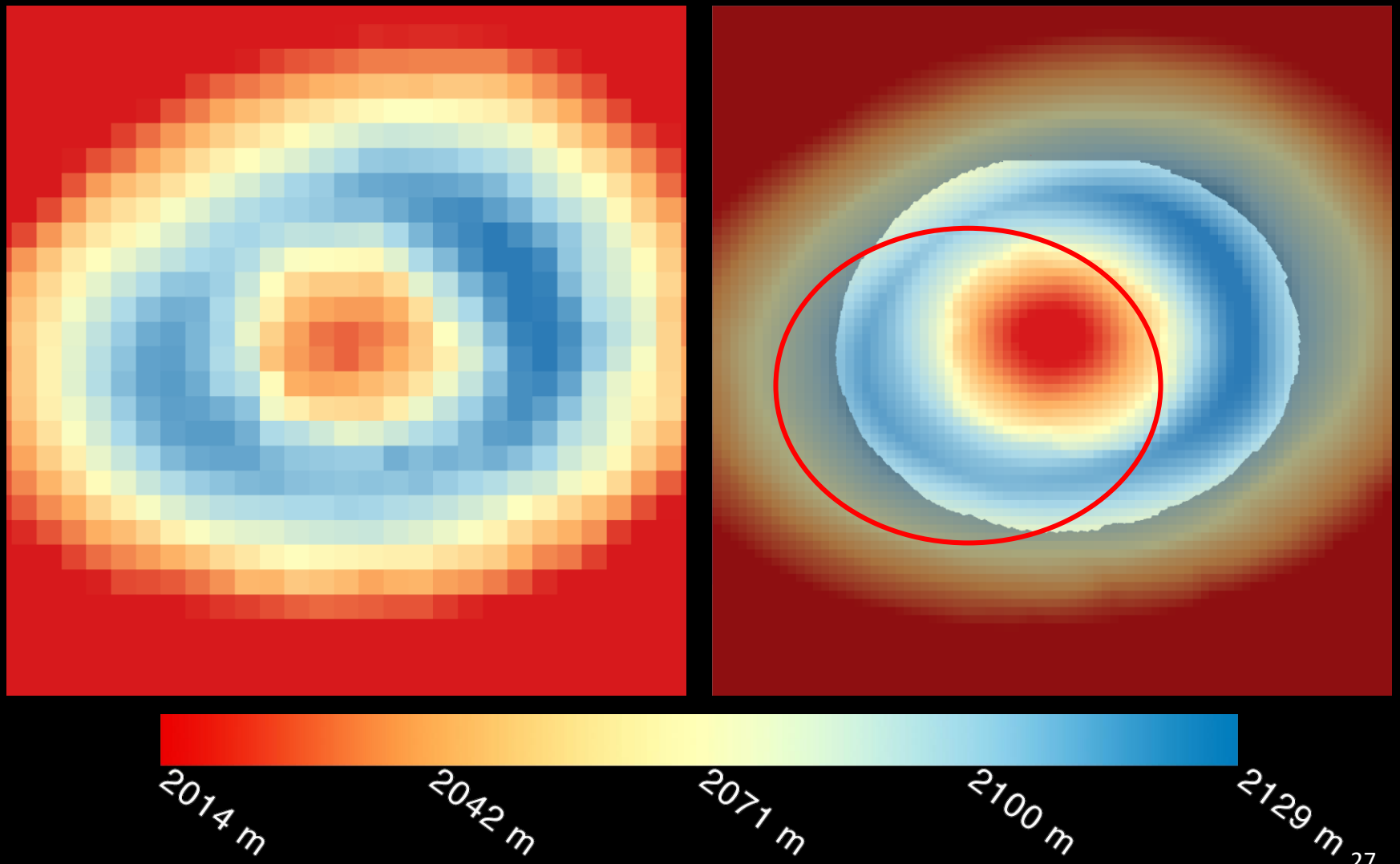
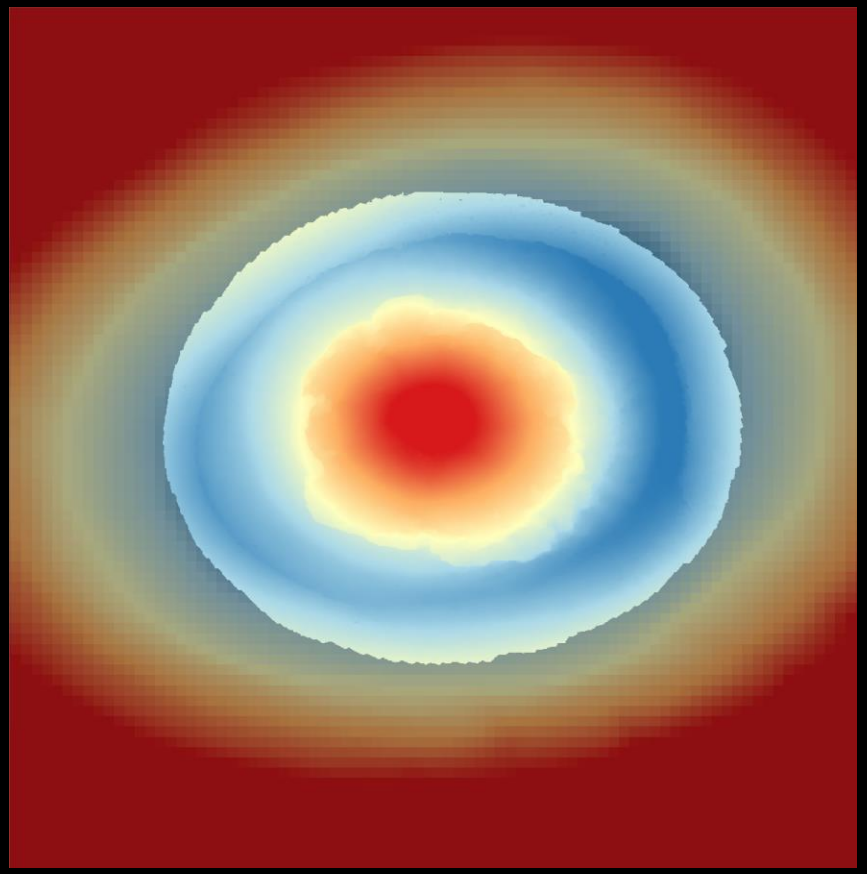
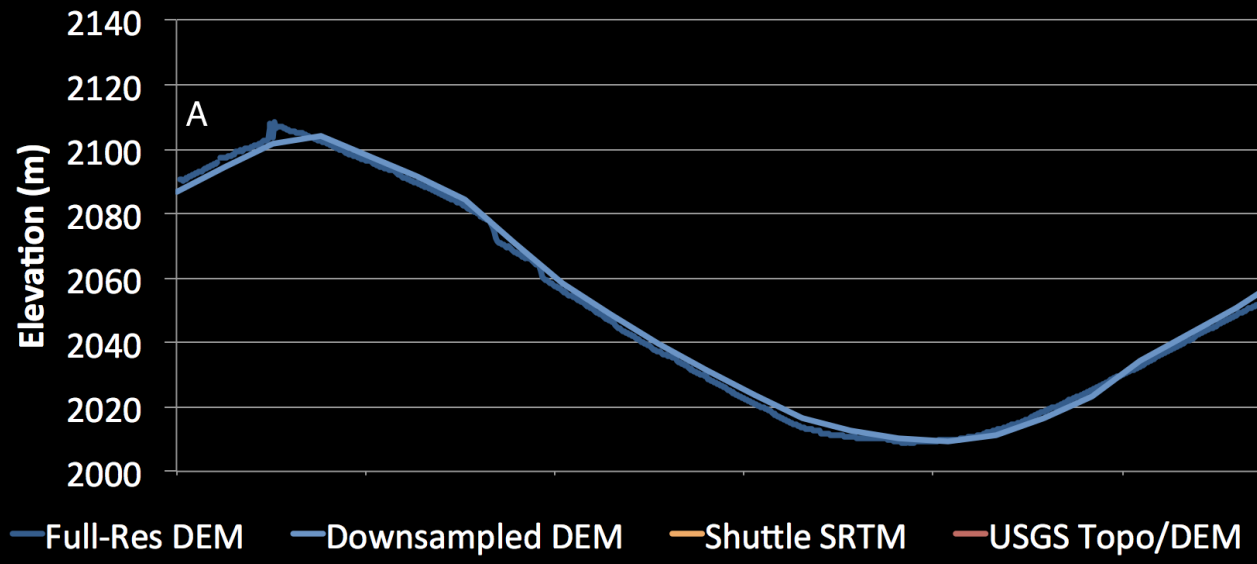
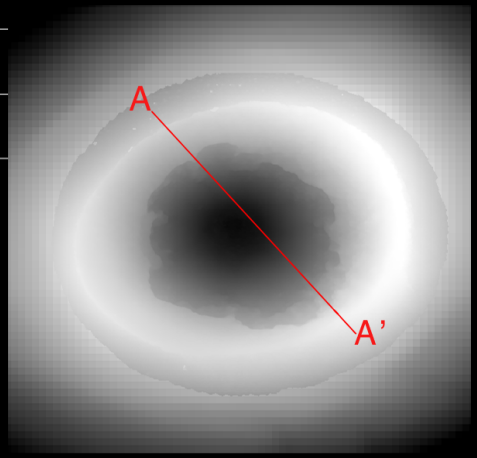


From drone video, rim is smooth



Topographic profile comparison





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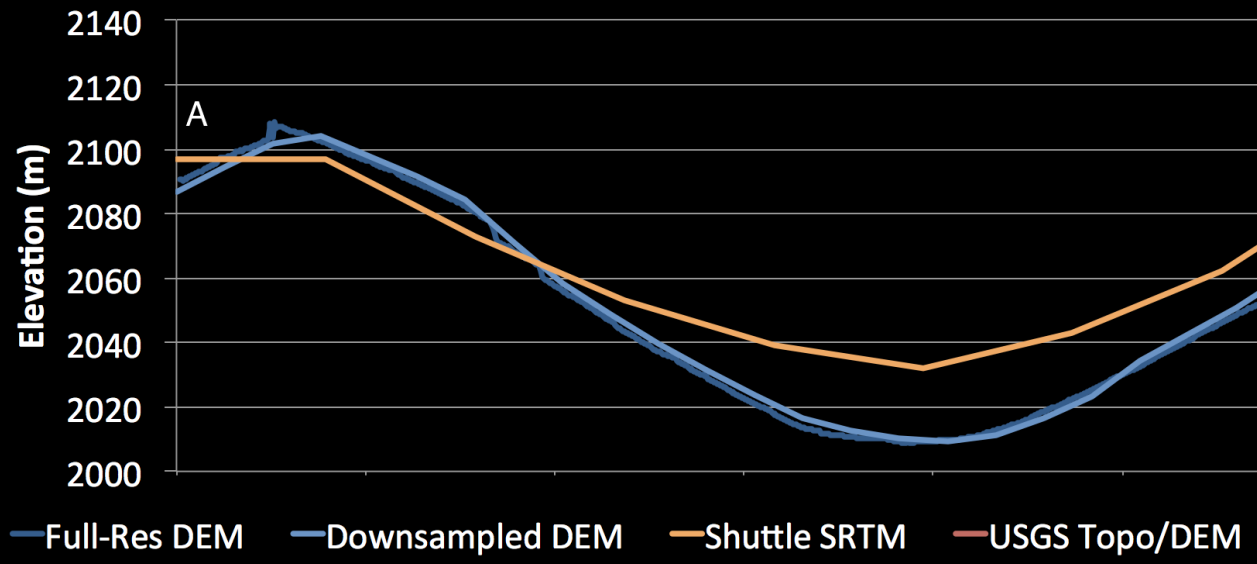

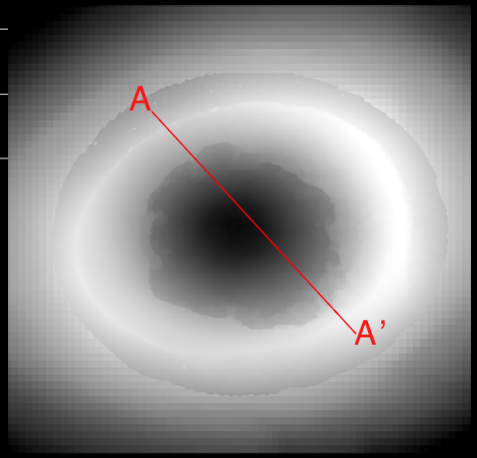

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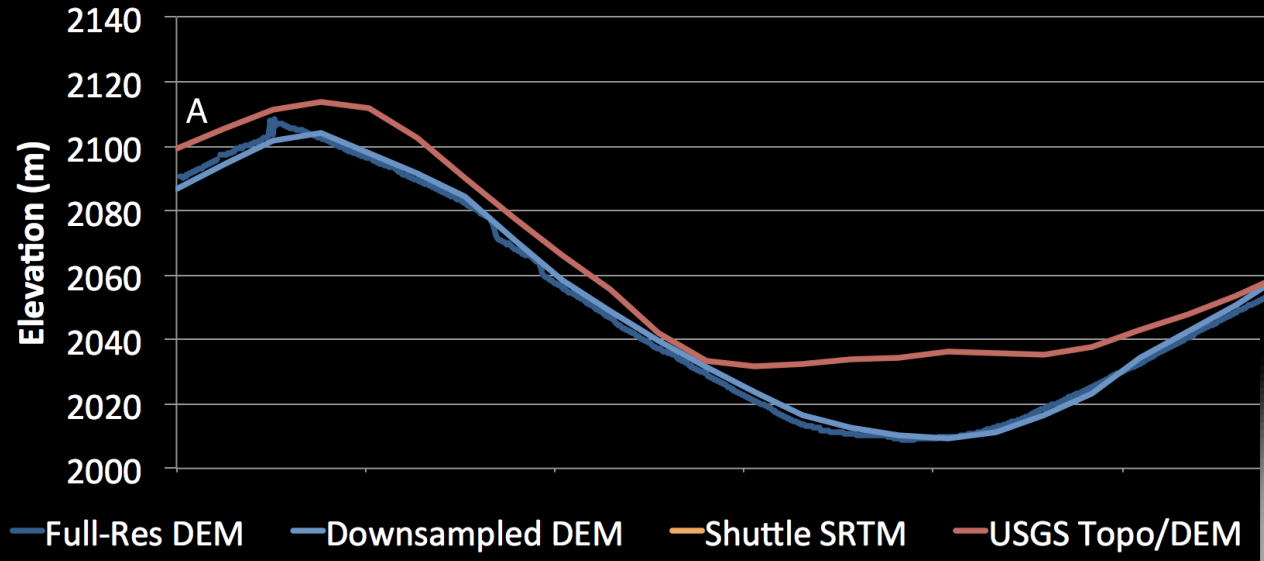

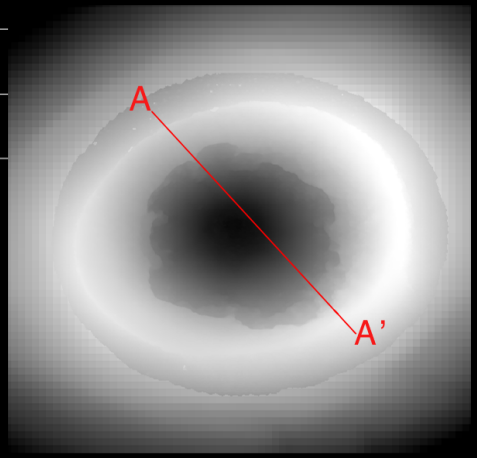

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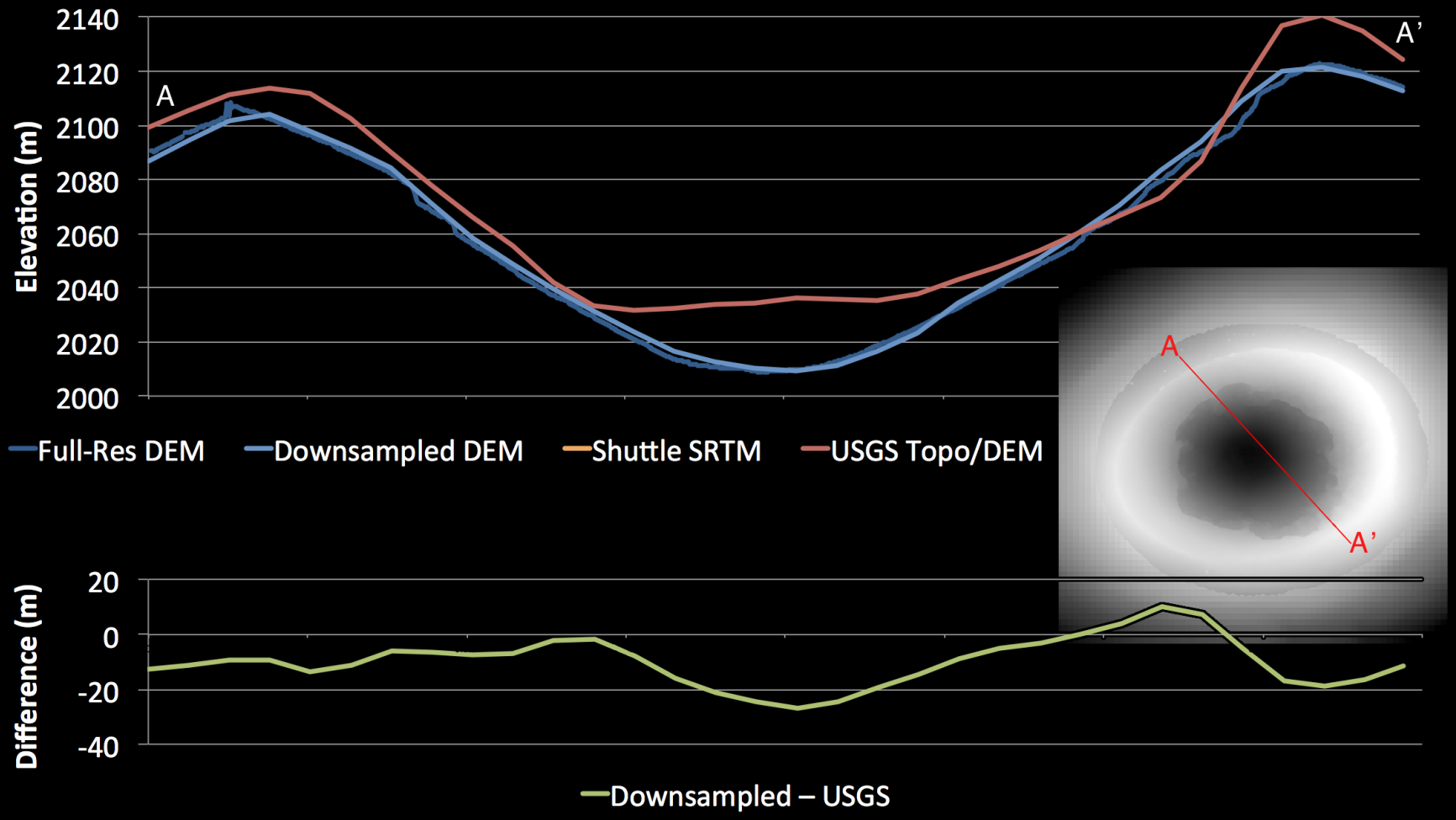

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Questions?

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