Augmenting Virtual Lunar Terrain with Procedural and Machine Learned Models in Real-Time

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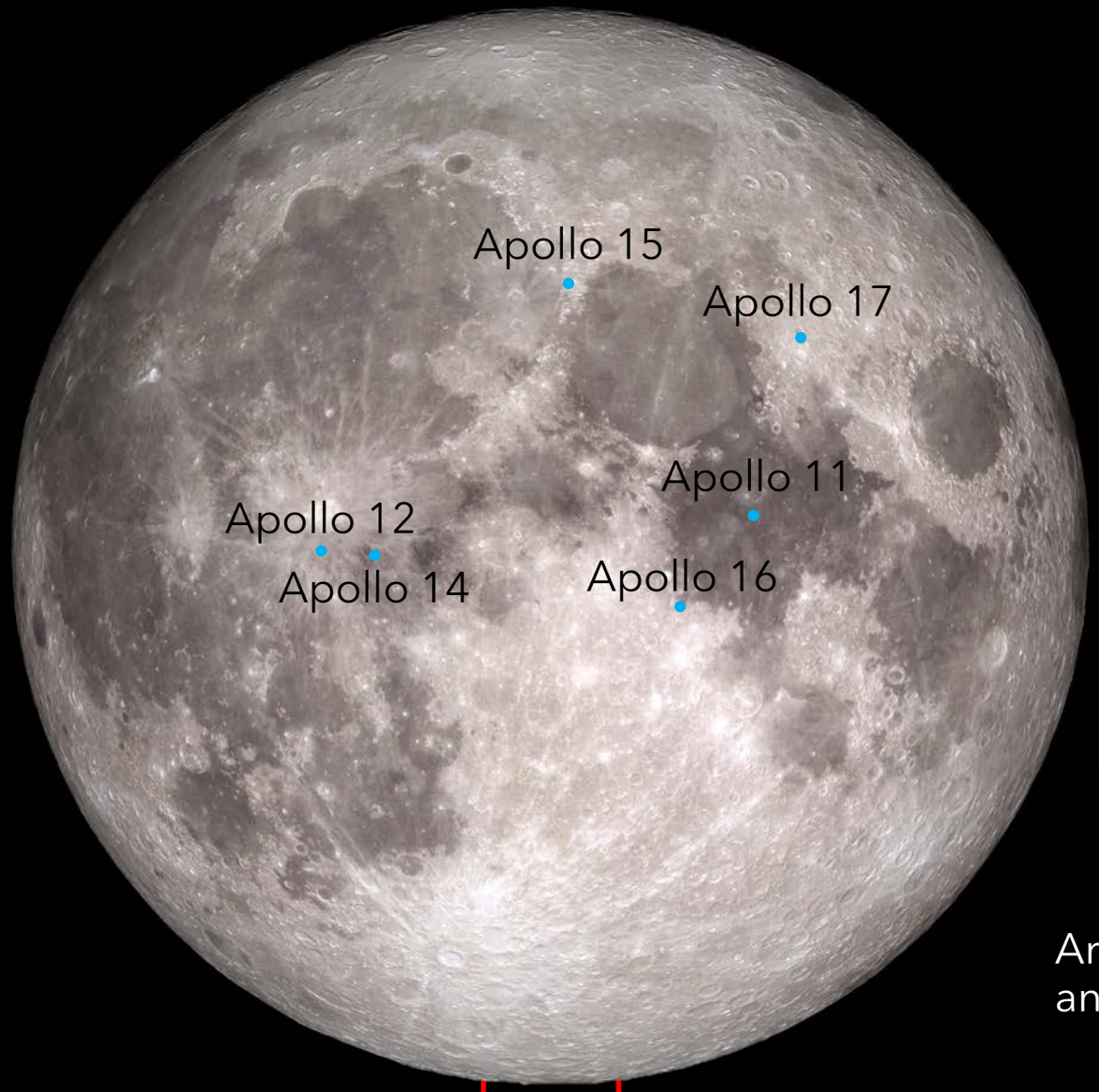
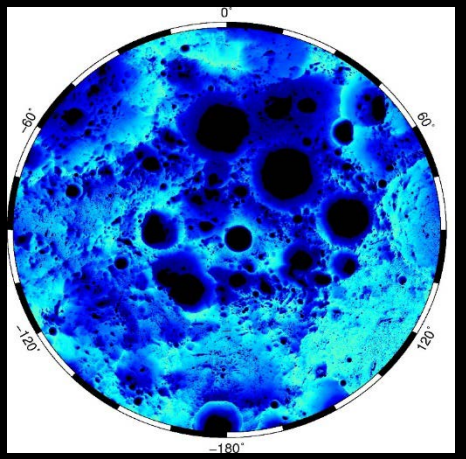


Artemis III and Future

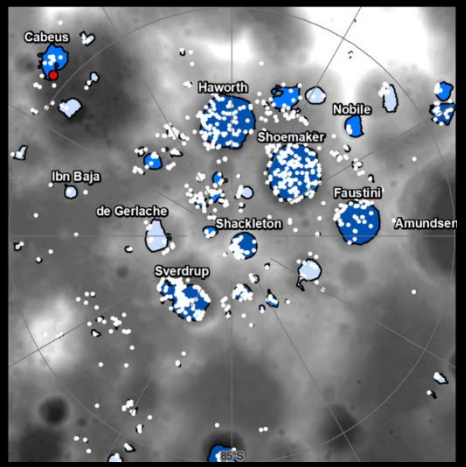
Sunlight

Mazarico et al. (2011)



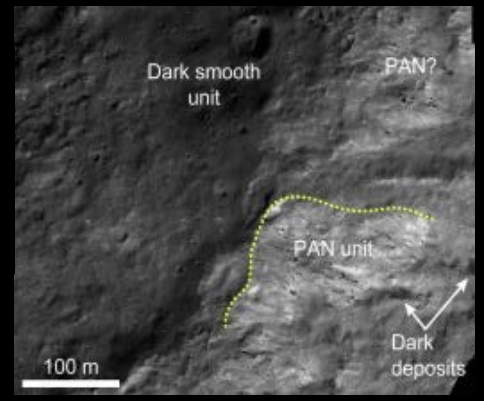
Water-Ice

Li et al. (2018)



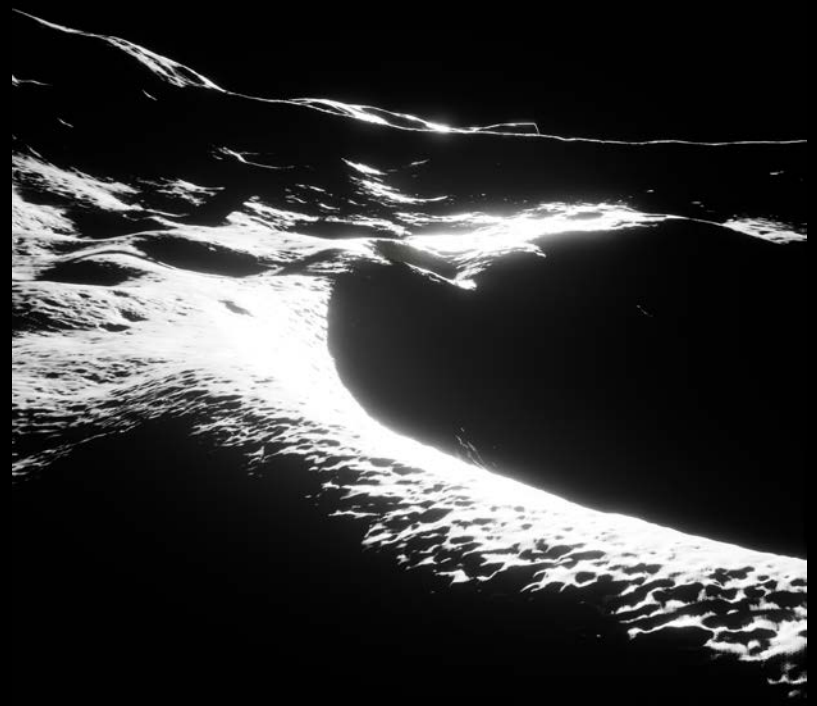
Rock resources

Gawronska et al. (2011)



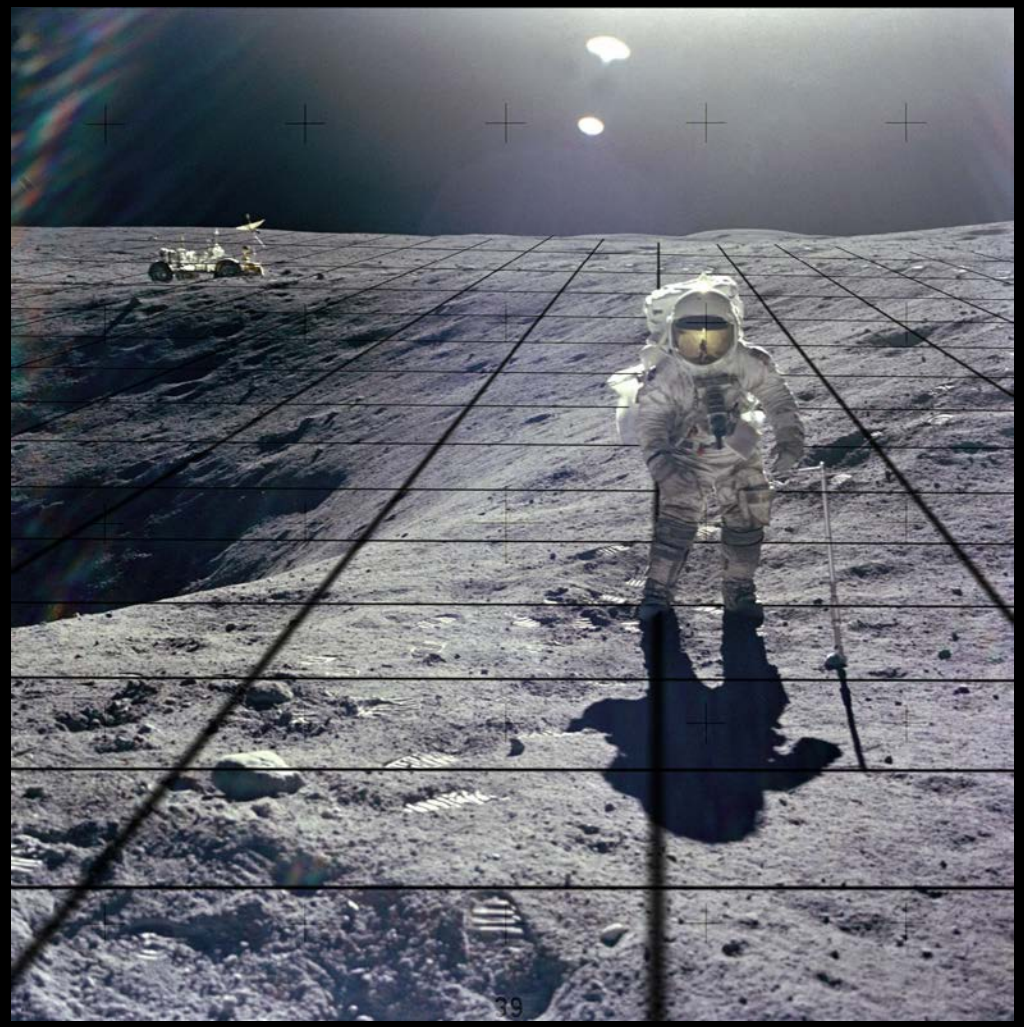
Lunar Image Data Input

Virtual Environment Output



Plum Crater Satellite Resolution Example (Apollo 16)

Elevation ~8 × 8 pixels @ 5 m resolution



Photograph ~40 × 40 pixels @ 1 m resolution

Lunar Photograph (1 meter/pixel)

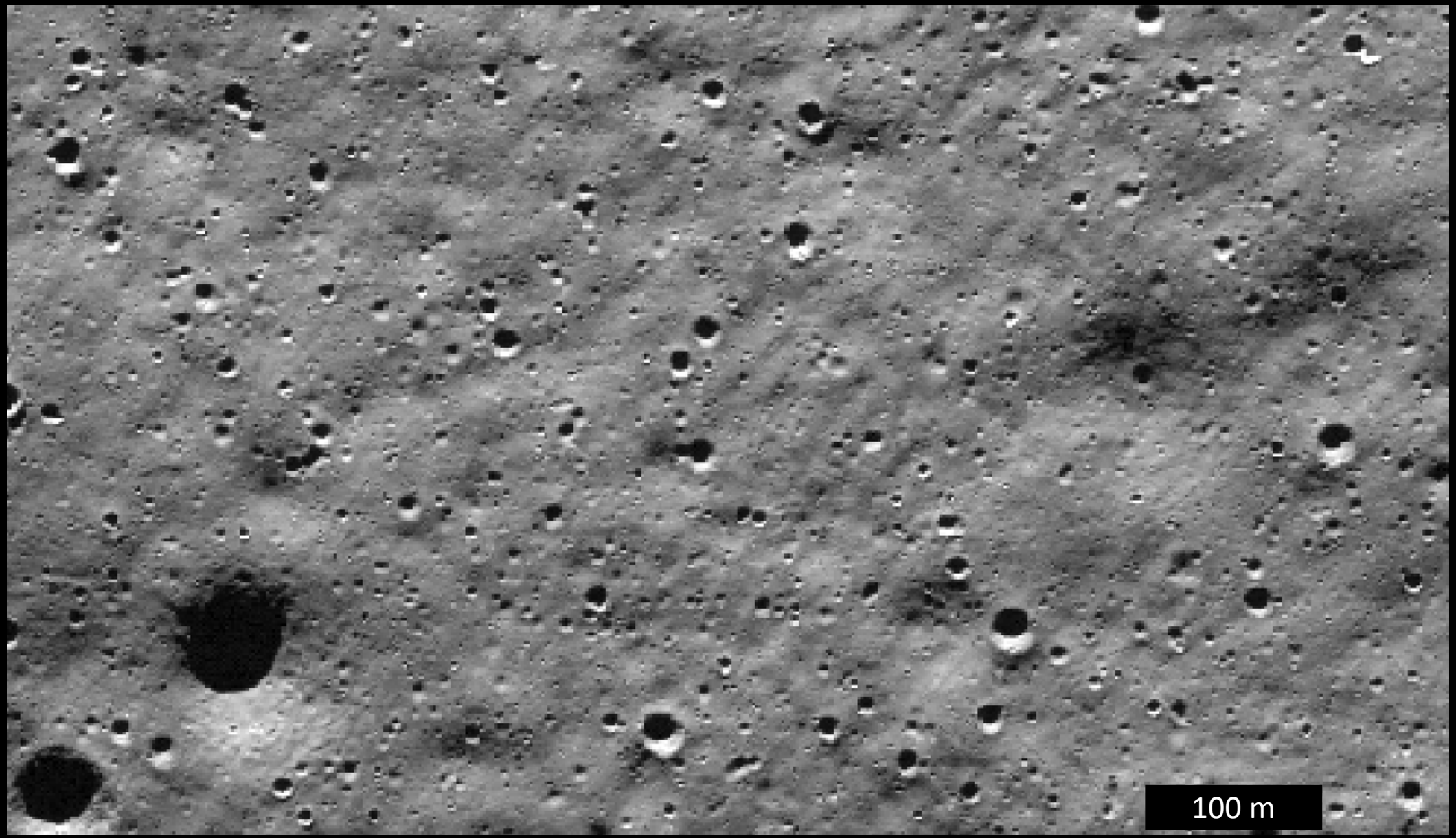


Image: NAC M1164797684RC

Craters with machine-learned classes

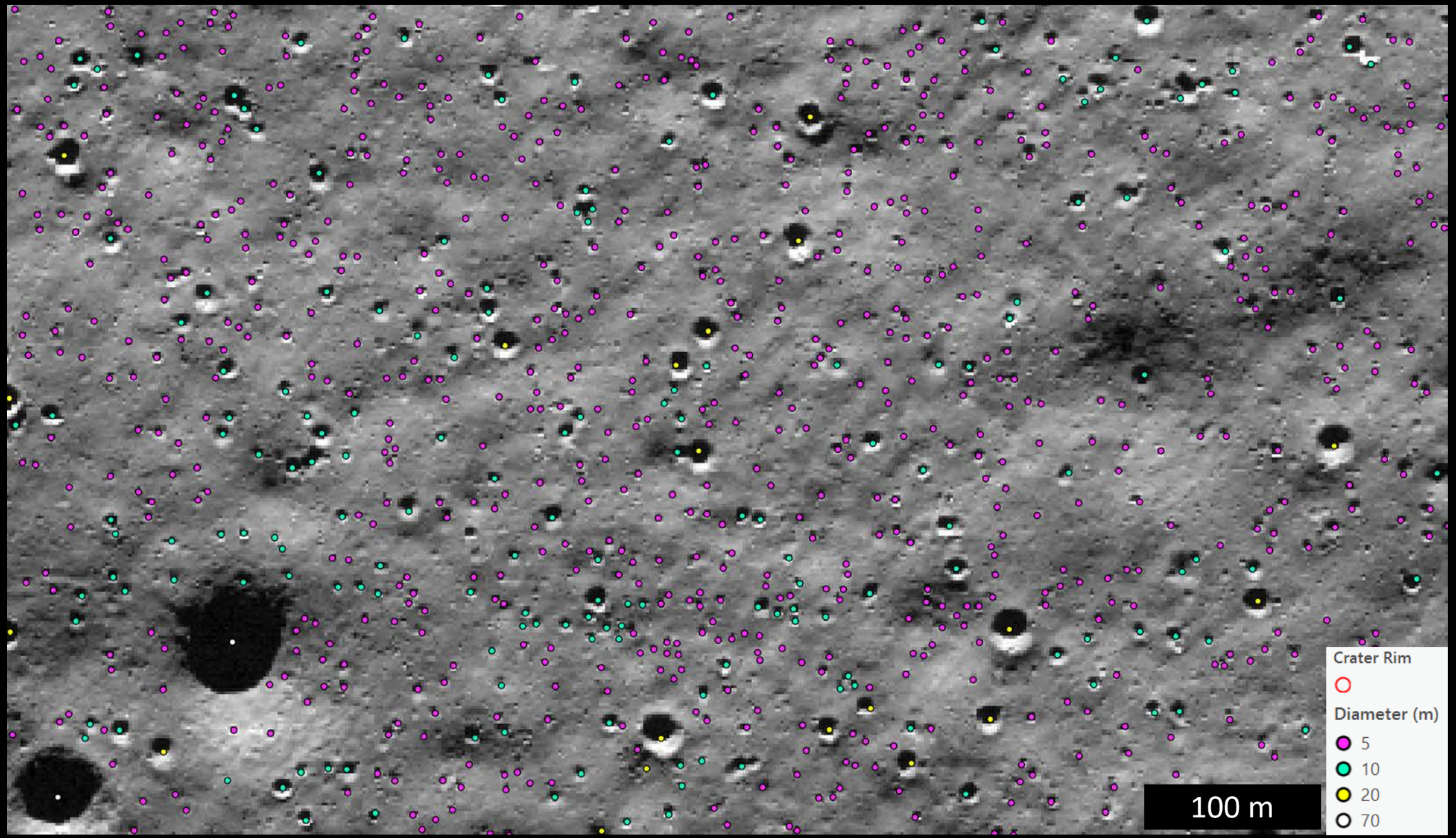
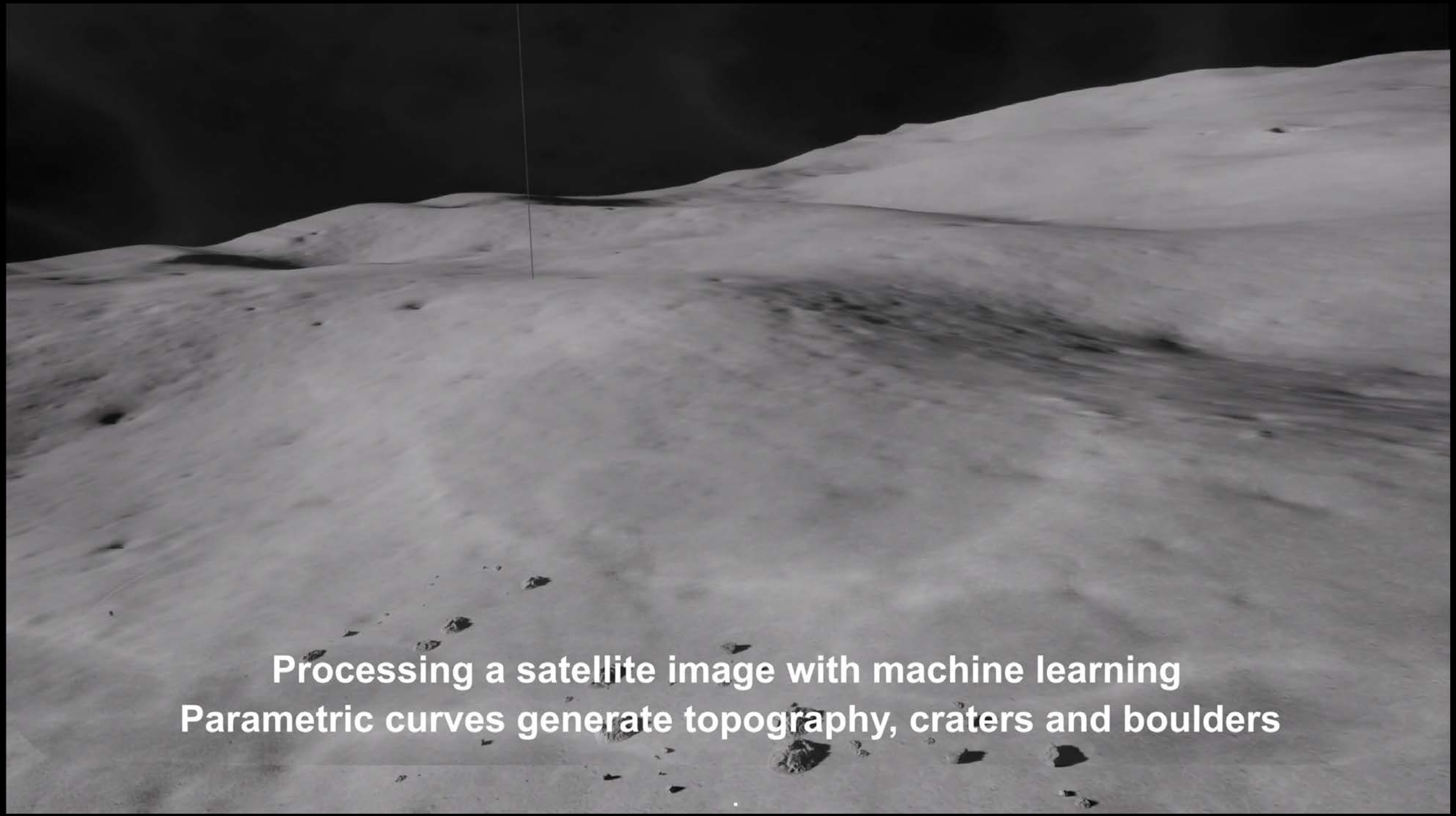
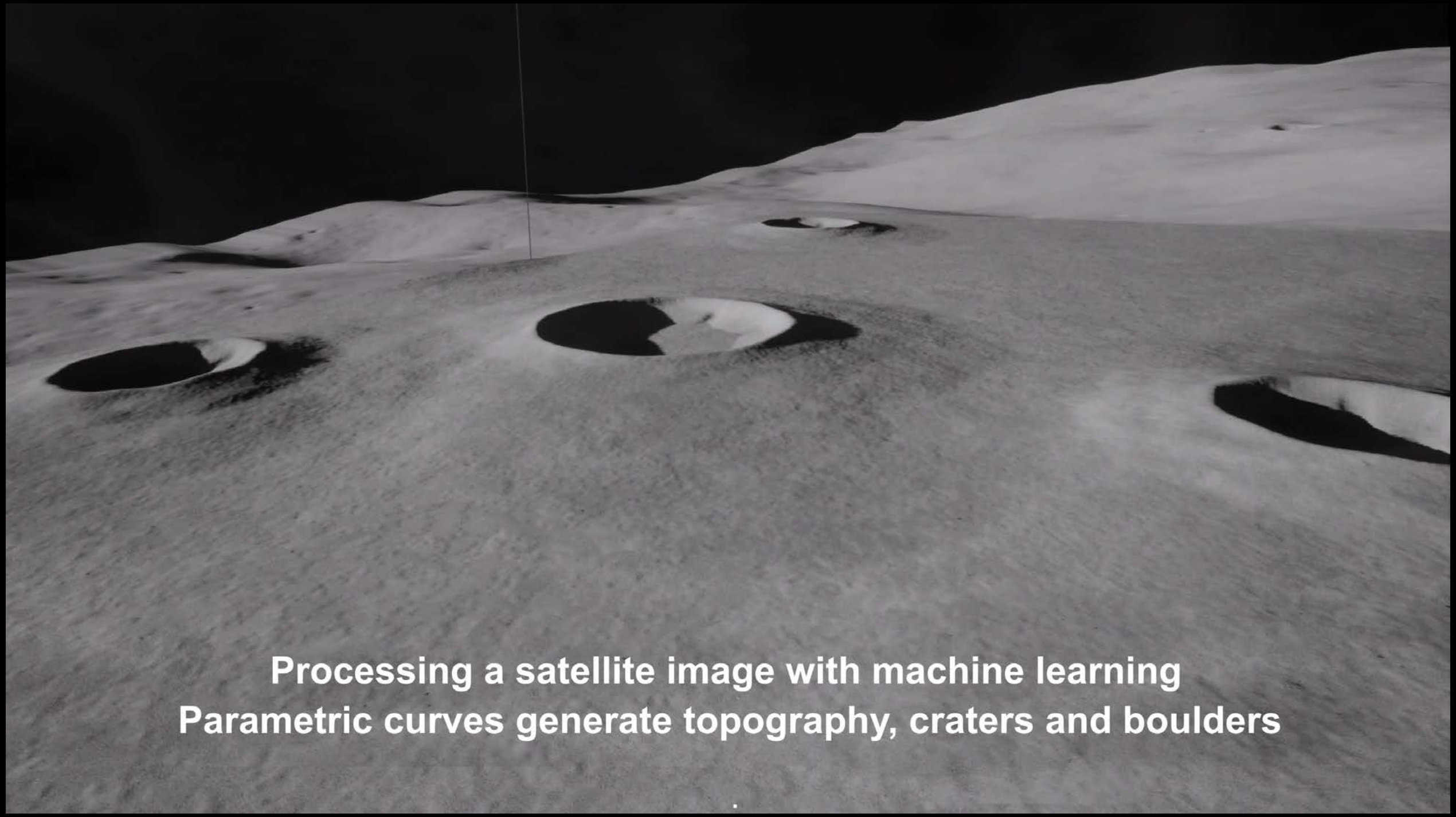


Image: NAC M1164797684RC


Processing a satellite image with machine learning
Parametric curves generate topography, craters and boulders



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Rock and Boulder Mapping

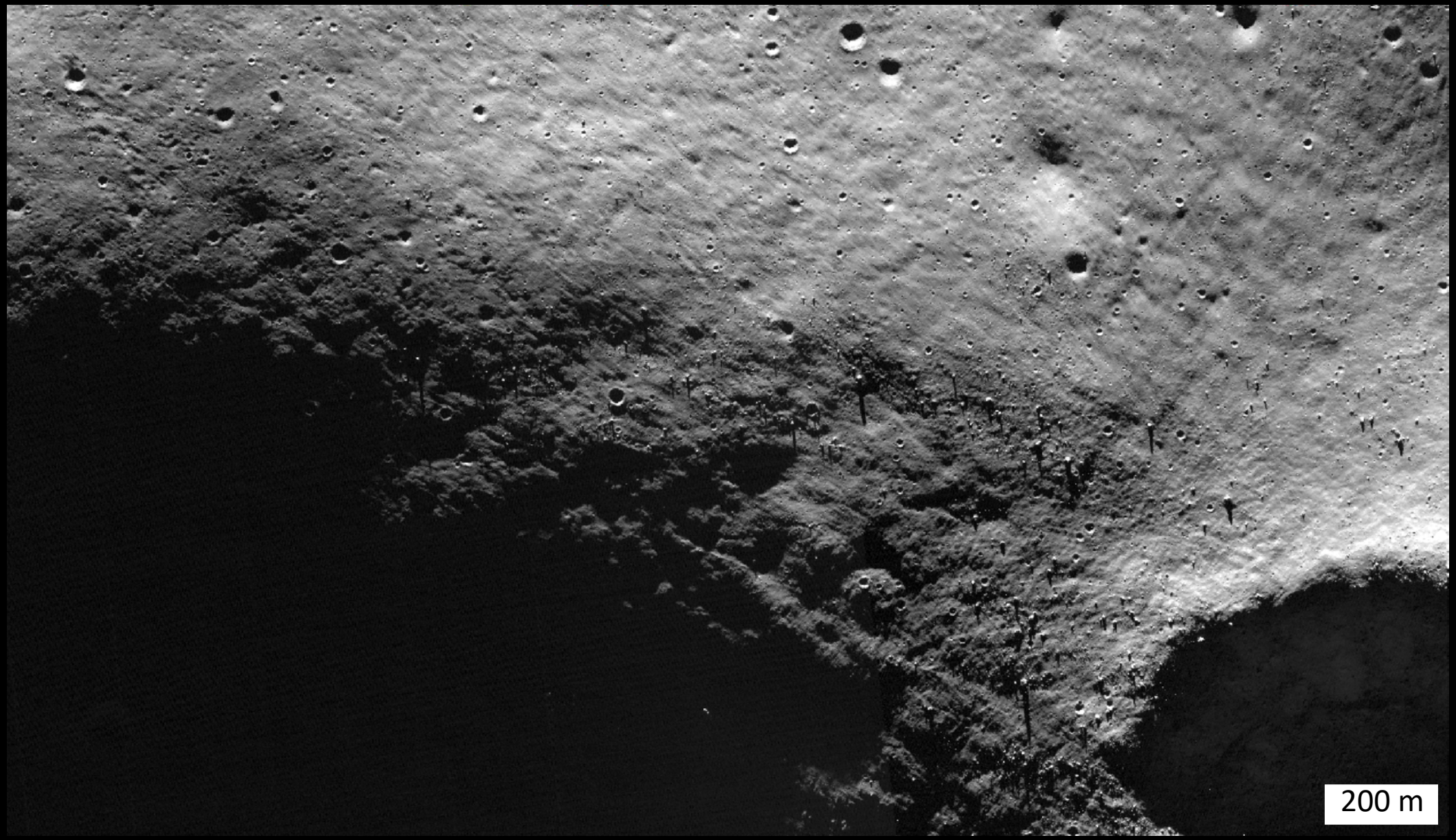


Image: NAC 1346004678RC; 1346011702RC

Rock and Boulder Mapping

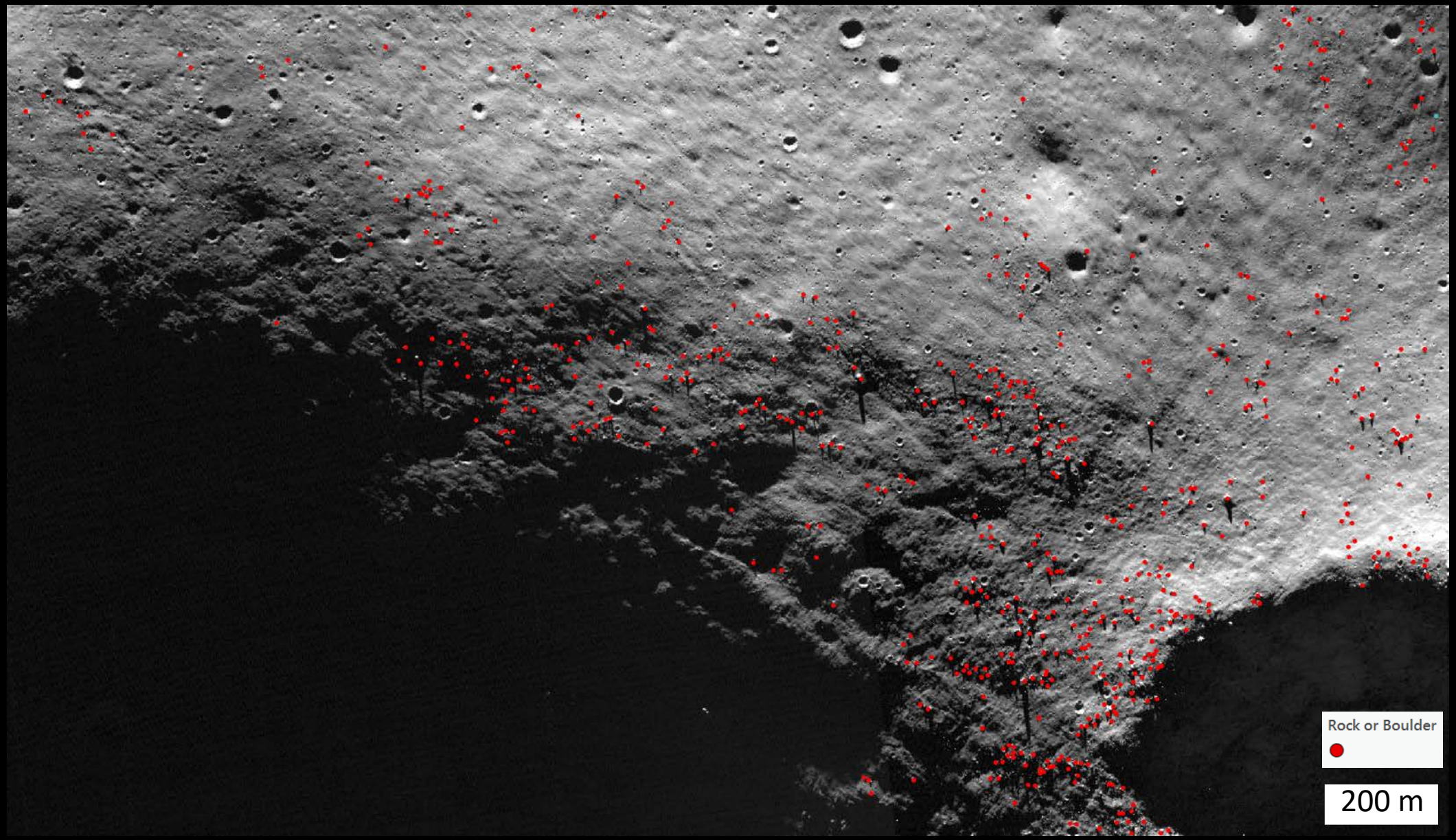
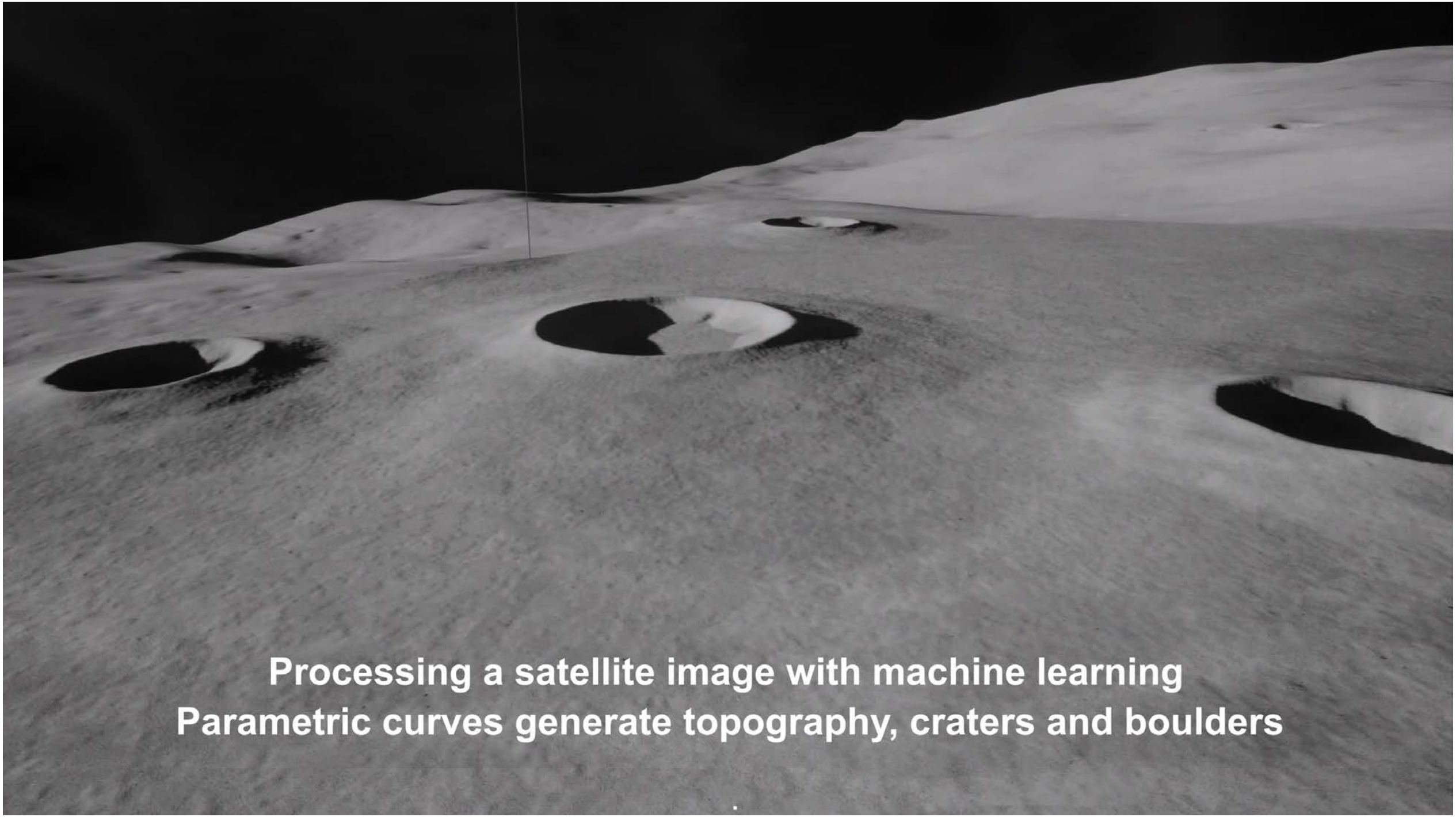


Image: NAC 1346004678RC; 1346011702RC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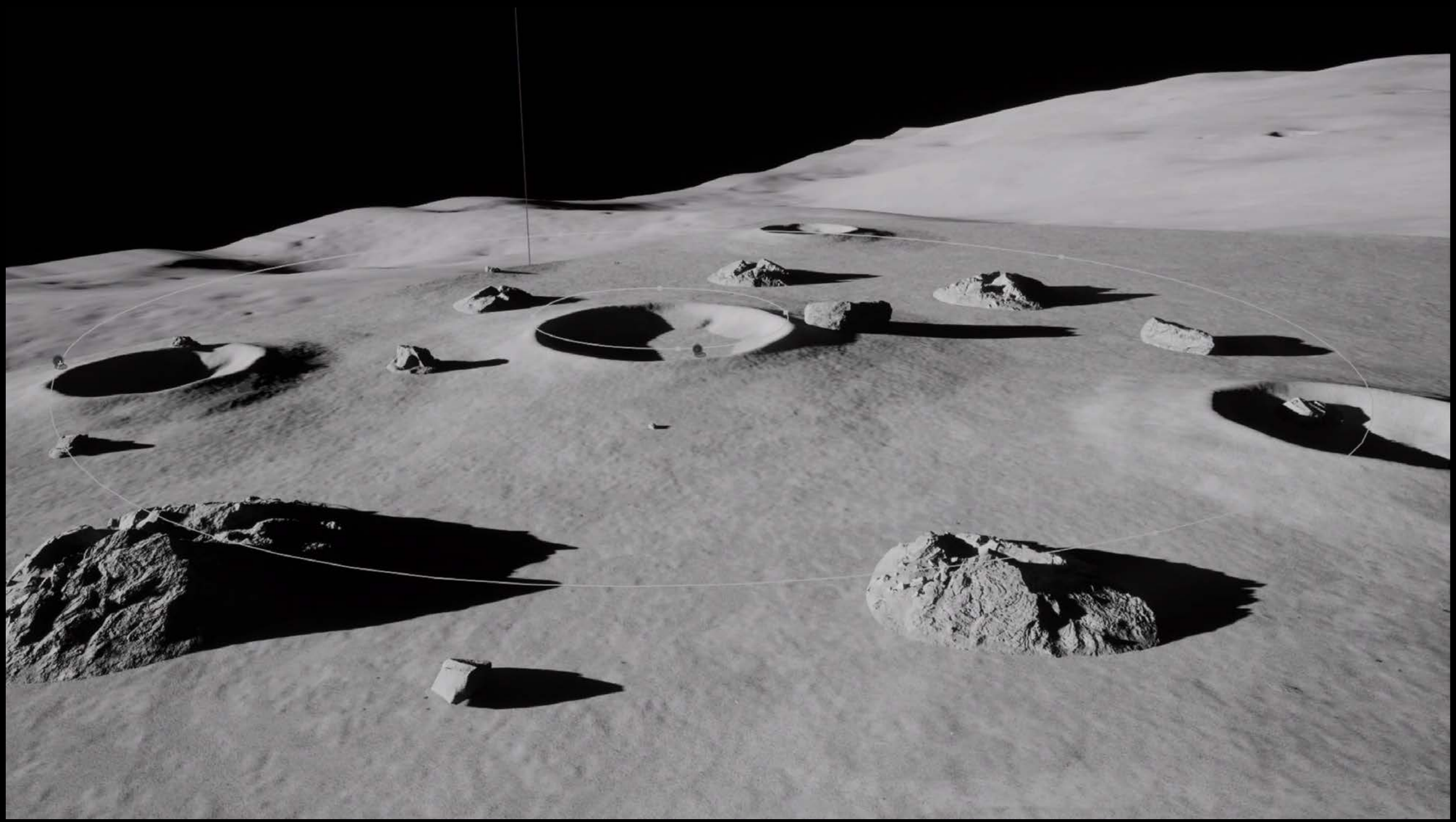


Procedural Rock and Boulder Distribution

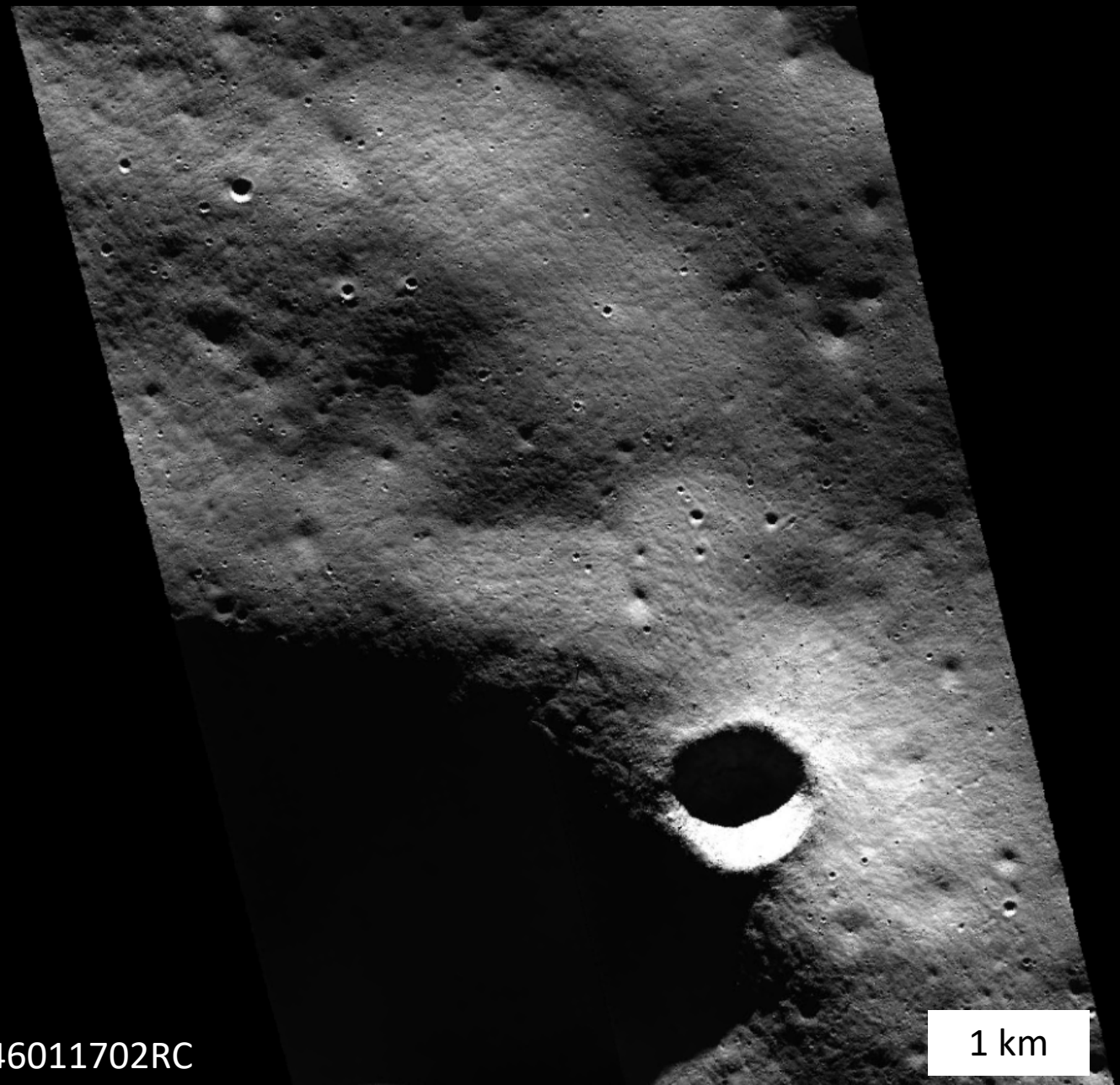


Image: NAC 1346004678RC; 1346011702RC

Procedural Rock and Boulder Distribution

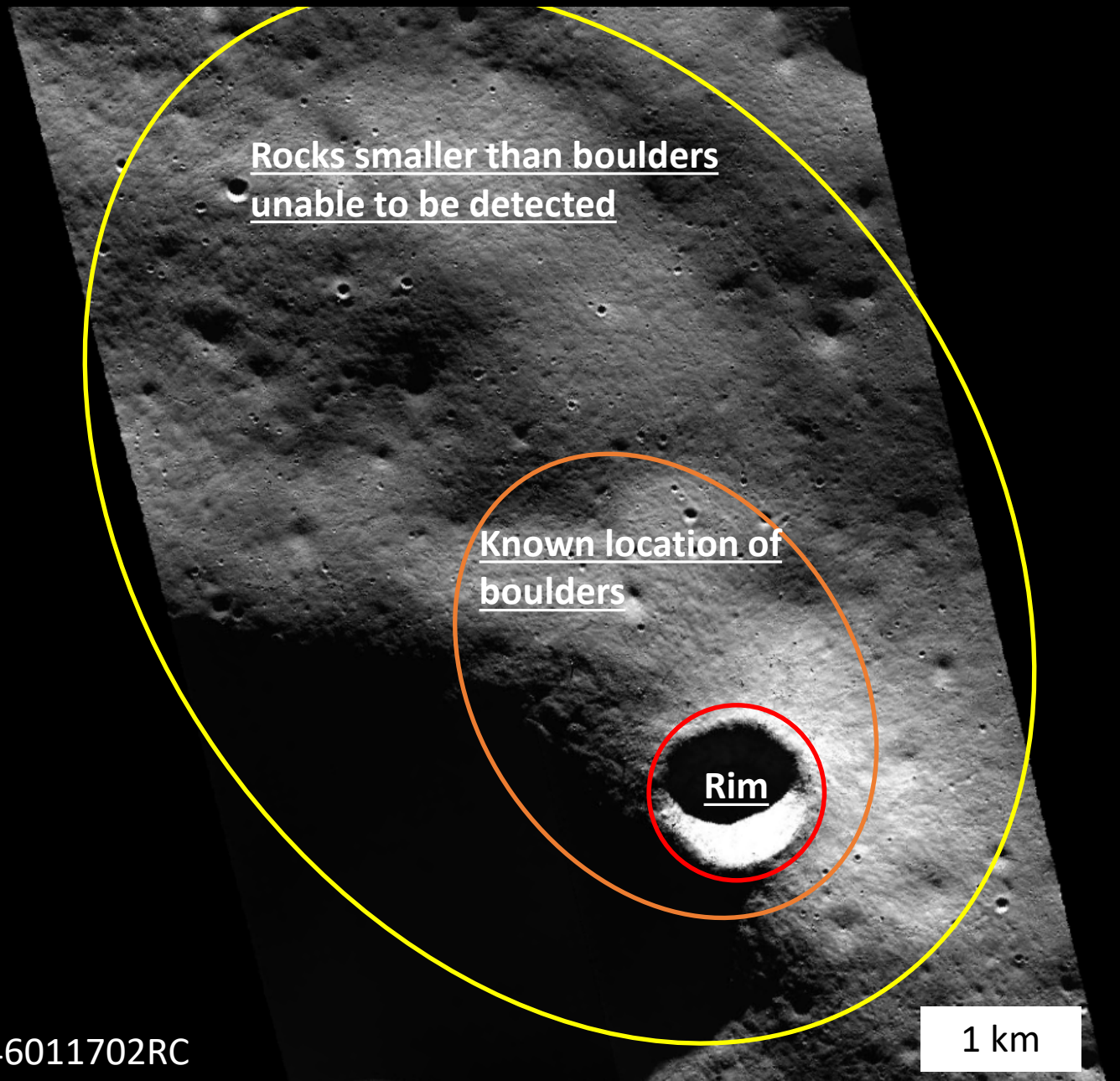
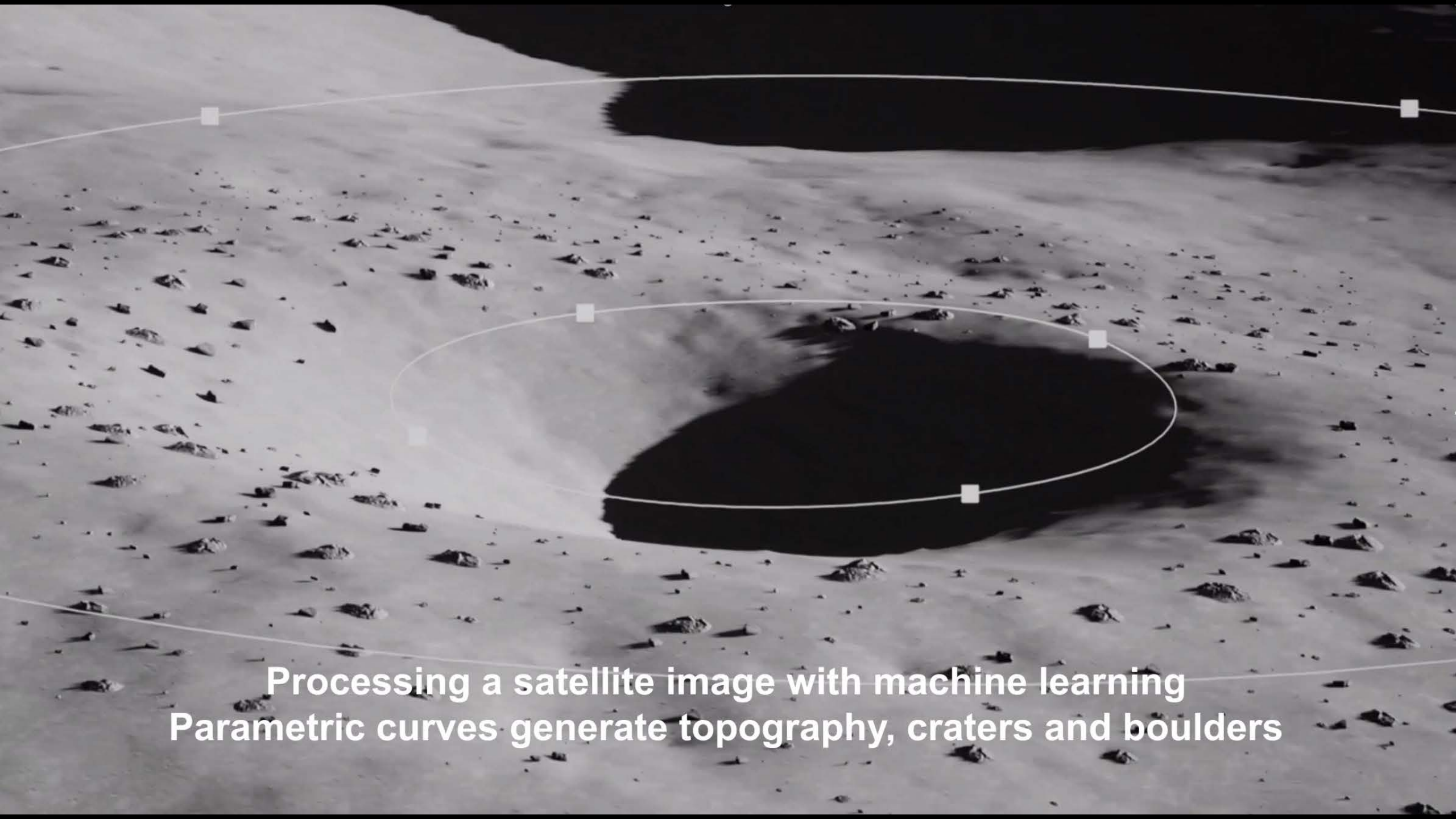


Image: NAC 1346004678RC; 1346011702RC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Summary

Produced a virtual lunar environment, able to:

- Classify craters and boulders using machine-learning clustering algorithms
- Distribute small craters and rocks otherwise unseen by current satellite data
- Augment the lunar terrain to resolutions of 20 cm or less
- Place the potential of billions of objects based on a spline-curve format
- Procedurally texture the lunar surface based on elevation, slope, and photographs

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