Simulating space missions with the
SurRender software

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https://www.airbus.com/SurRenderSoftware.html

AIRBUS

The development and validation of computer vision algorithms require image simulation tools that achieve a very high level of physical accuracy and image representativity. To this end, Airbus Defence and Space has developed the image simulation software: SurRender® (v6).

Highly realistic simulations
Simulated vs real images

SurRender   *New Horizons*

Fine sensor modeling (HAS3)
Windows with different integration times
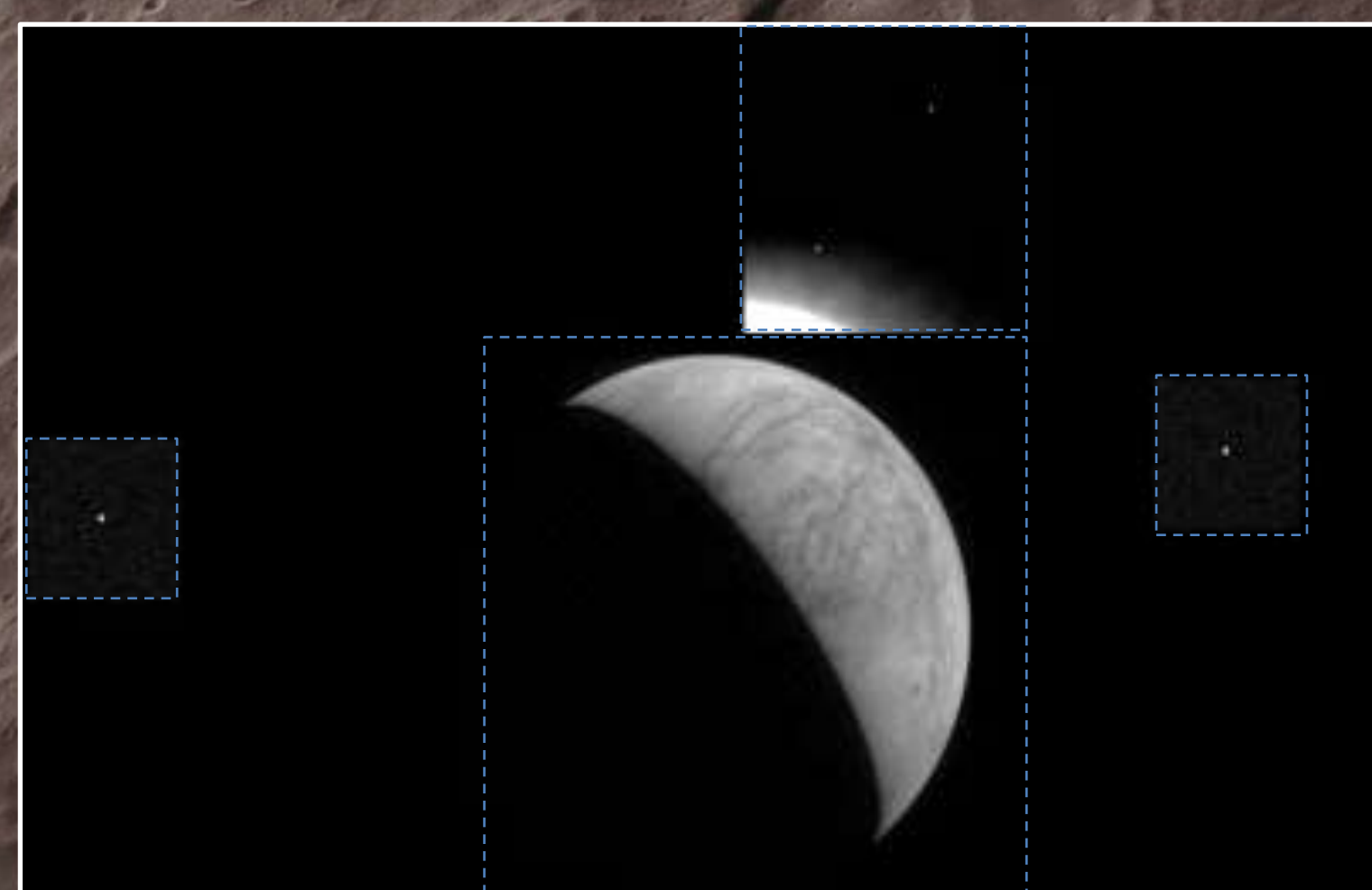
Indirect illumination and blooming
*(Sun + Jupiter light on Europa)*

- Recursive raytracing: optimized for space scenarios
- Computational efficiency: from real-time to physically accurate
- Very large datasets: Digital Elevation Models & textures, procedural generation
- Very large distance dynamics: double precision from Solar System scale to contact
- Sub-pixel accuracy: efficient sampling of small objects, limb imaging
- Many optical effects: reflections, dropped shadows, indirect light sources, eclipses
- Multiple interfaces: Matlab, Simulink, C++, Lua, Python (client/server link)
- GUI for custom models: shapes, materials (BRDF), sensors, variable PSF, …
- Advanced camera models: geometry, optics, motions, detector, noises, etc.
- Cloud computing: efficient parallelization for Monte Carlo campaigns
- Current developments : open-source deployment of the SurRender client (I/F)

Sensor models
Jupiter & its moons with extreme achromatism (for illustration)

Continuous simulation over high distance range
67P/CP ("Chury") at 1000 km and 10 km
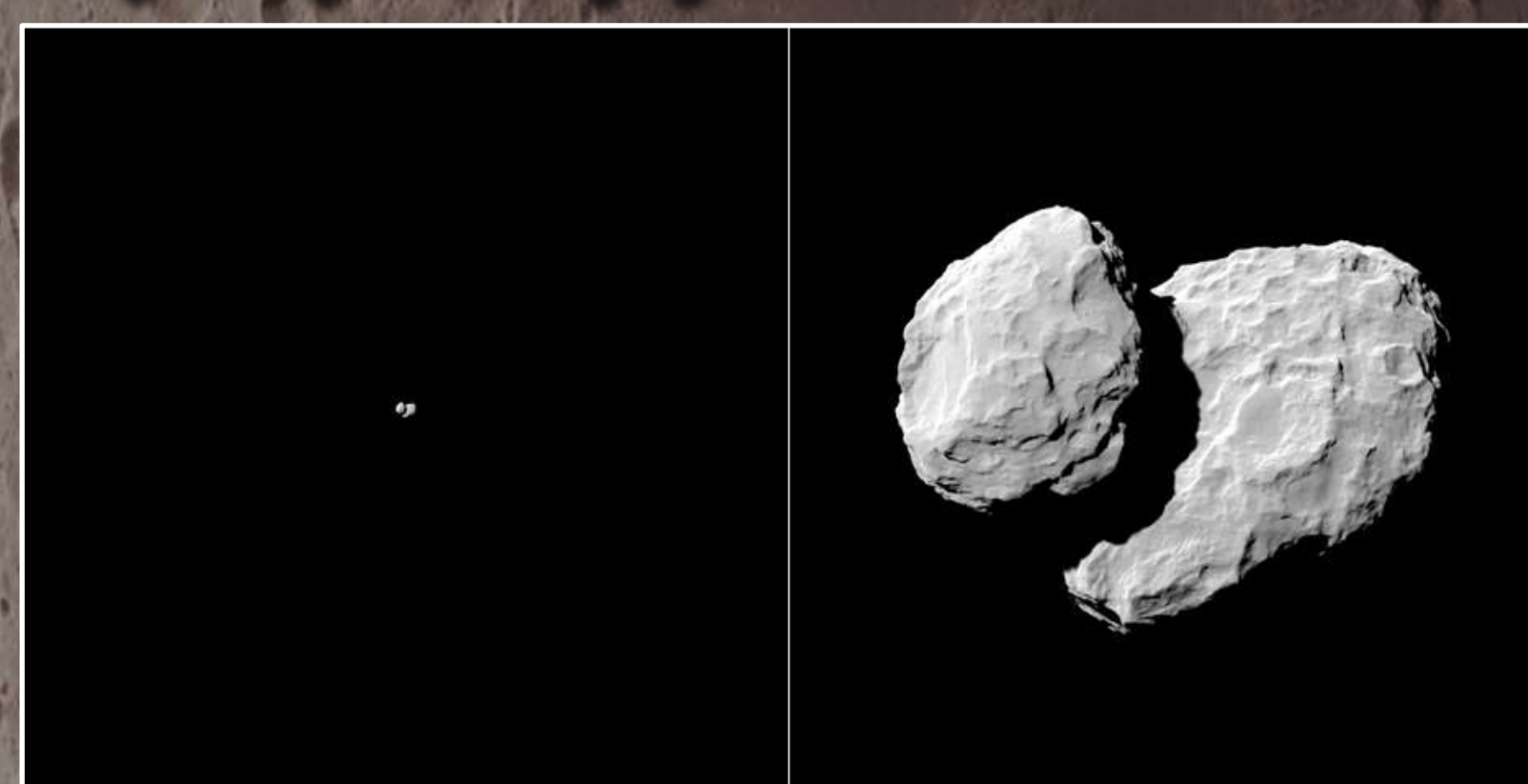
Artificial objects (space rendezvous)
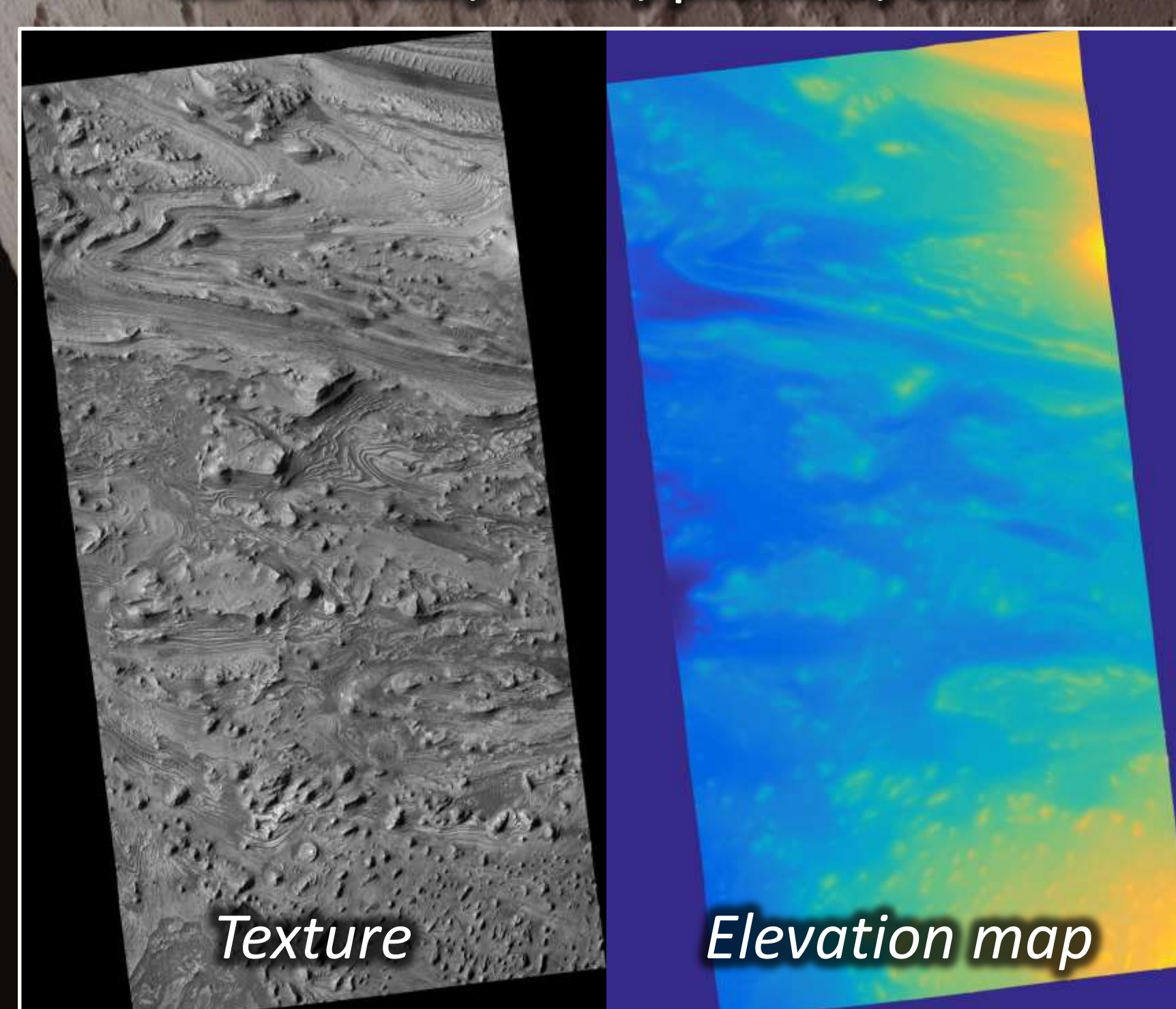*Simulated view of SPOT 5 and ENVISAT*

Planet-wide simulations
Ceres from Dawn DEM & albedo maps

Scene Models
3D models, DEM, planets, stars
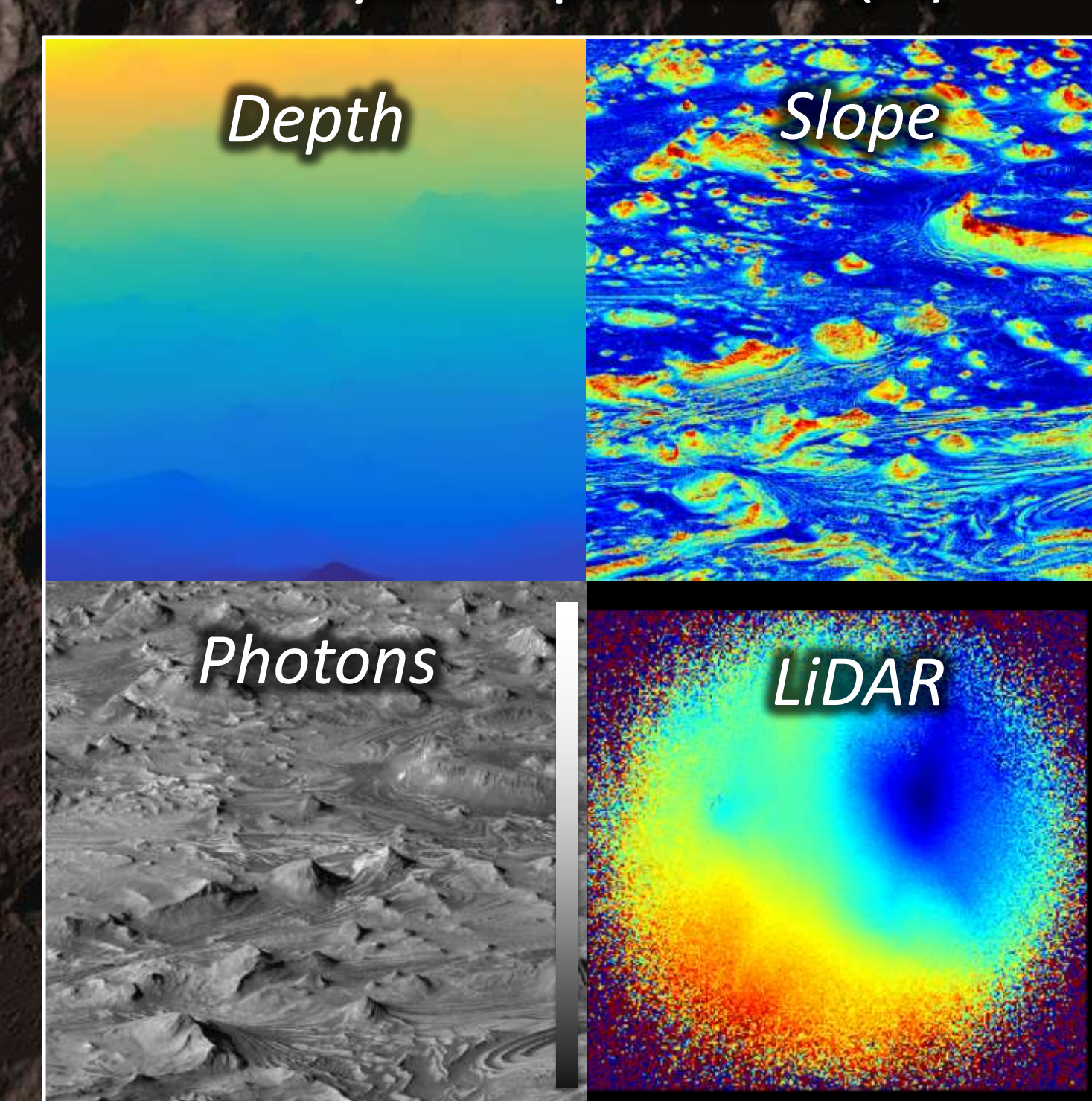

Texture   *Elevation map*

Sensor model
Optics (PSF, achromatism, distortions, stray light, …)
Detector (QE, bands transmission, noises, …),
Sequencing (rolling shutter, windowing, …)

Data
(Ephemeris, metadata, etc.)

SURRENDER

Output
Physical quantities (SI)

Depth   *Slope*

Photons   *LiDAR*

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References for the datasets available upon request