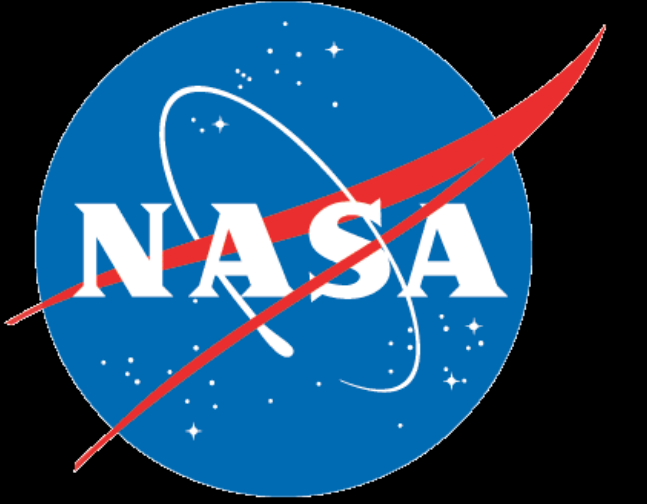


Celestial Mapping System for Lunar Surface Mapping and Analytics



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Background

Celestial Mapping System (CMS) is a software platform to generate virtual 3D globes for celestial bodies. Various layers are built on top of the virtual globe to provide visualization of high-resolution imagery, enable precise measurements, build analytical capabilities and provide a broad range of functionalities.

CMS supports importing synthetic features in a variety of 3D, 2D, vector and raster formats. It will run on a wide variety of platforms such as Linux, Windows, and OSX.

The present focus of CMS is on developing lunar mapping tool kits to provide features such as: 3D first person view with zoom and navigational capabilities, realistic terrain visualization, measurement tools, Apollo landing site annotations, stereoscopic view, elevation profiles, line of sight analysis and many more.

Key Attributes

- Path conforming Lat-Lon and GARS graticules to provide accurate analysis of the lunar surface (fig. 8/9).
- Stereo view brings out craters and prominent features (fig. 5).
- Support for integrating 3D objects to simulate rovers, cislunar satellites, and landing vehicles.
- Broad range of visualization & analysis functionality for 3D globe view.
- Path conforming measurement toolkit.
- Dedicated server to integrate high-resolution imagery and data from recent missions.
- Display of geodetically accurate LRO LOLA Shaded Relief maps at 473mpp, 388mpp, and 237mpp.
- Global elevation data derived from LRO LOLA DEM with a resolution of 118mpp.
- Lunar parameters derived from the standardized IAU2000 Moon spatial reference to ensure accurate distance and measurements.

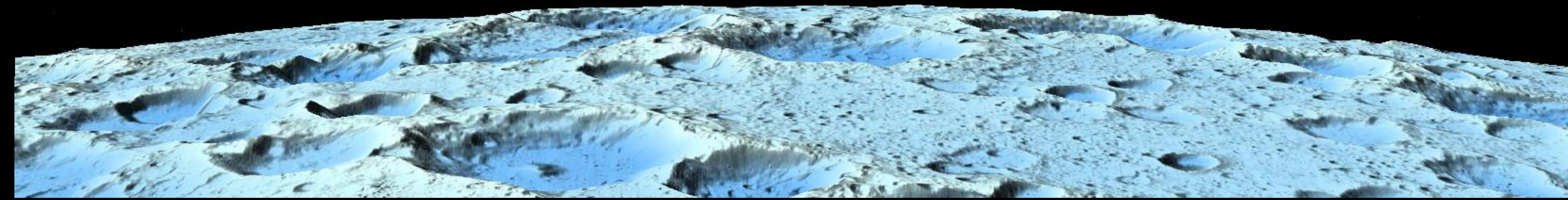


Fig. 1. 3D terrain with LOLA Color Shaded Relief Blue Steel derived from LRO elevation data

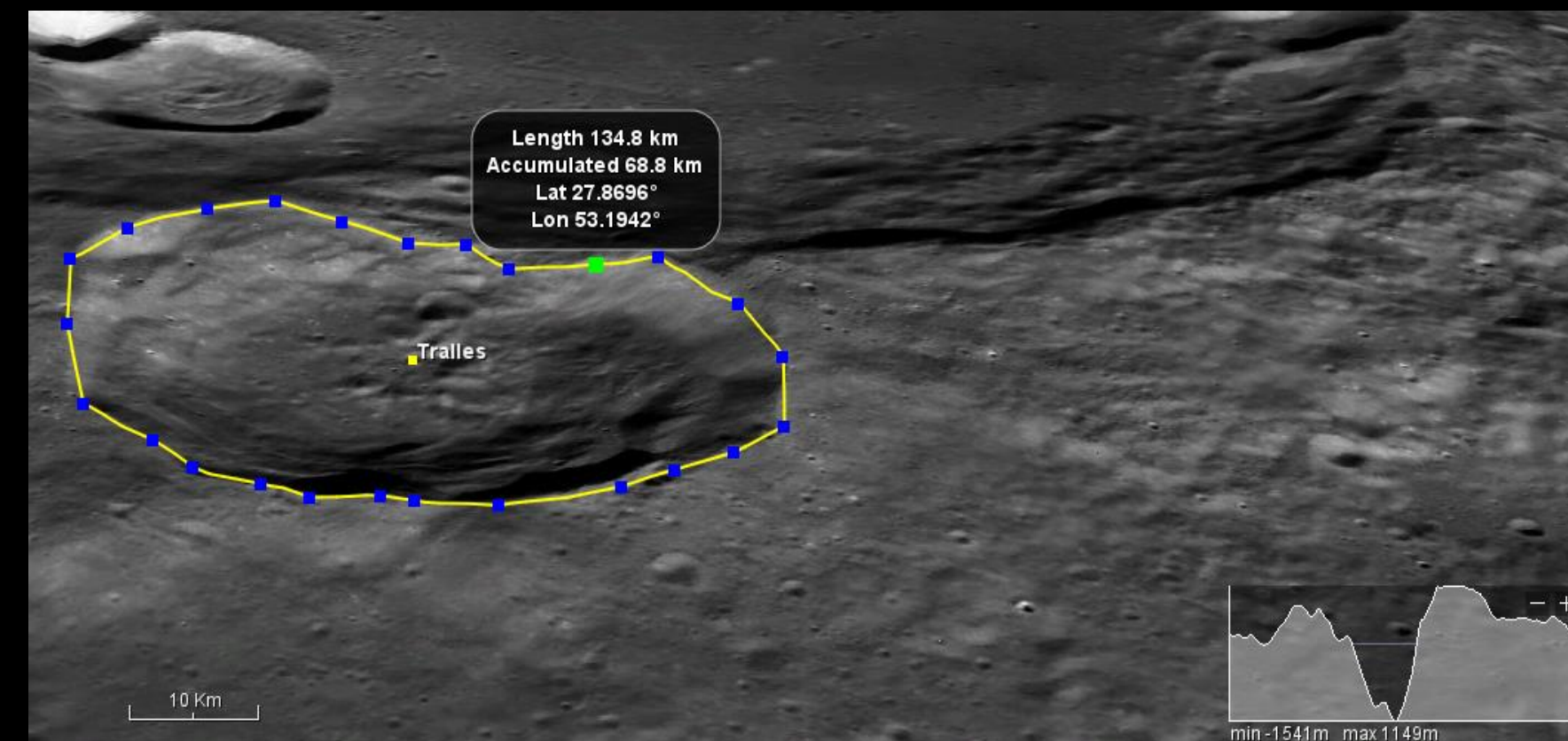


Fig. 2. Measuring area of irregular crater Tralles



Fig. 3. High-res view of Apollo 15 with 3D astronauts and craft

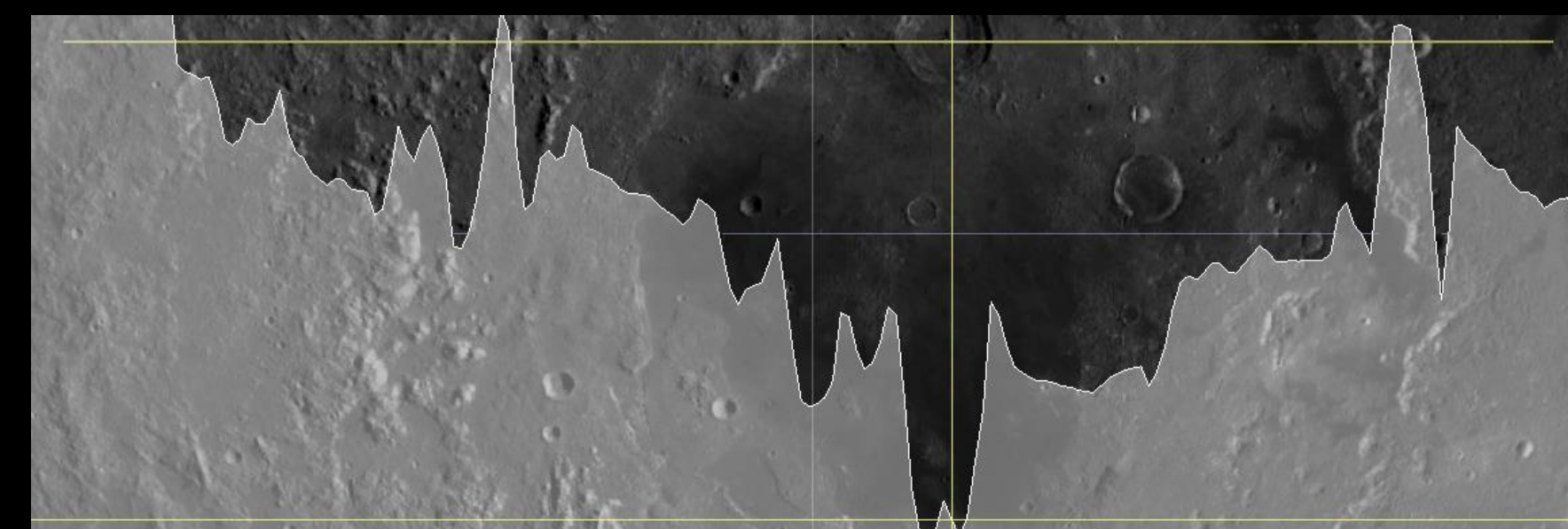


Fig. 4. Analyzing the elevation profile of Mare Orientale

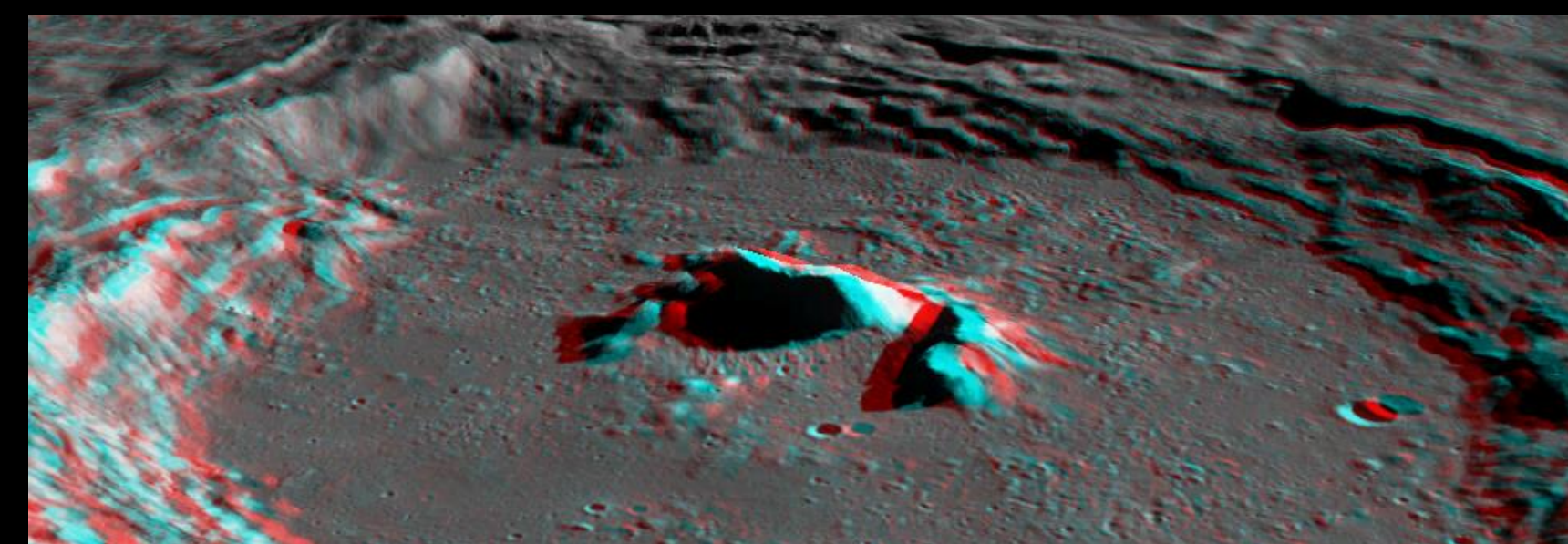


Fig. 5. Displaying a mountainous crater in stereo view

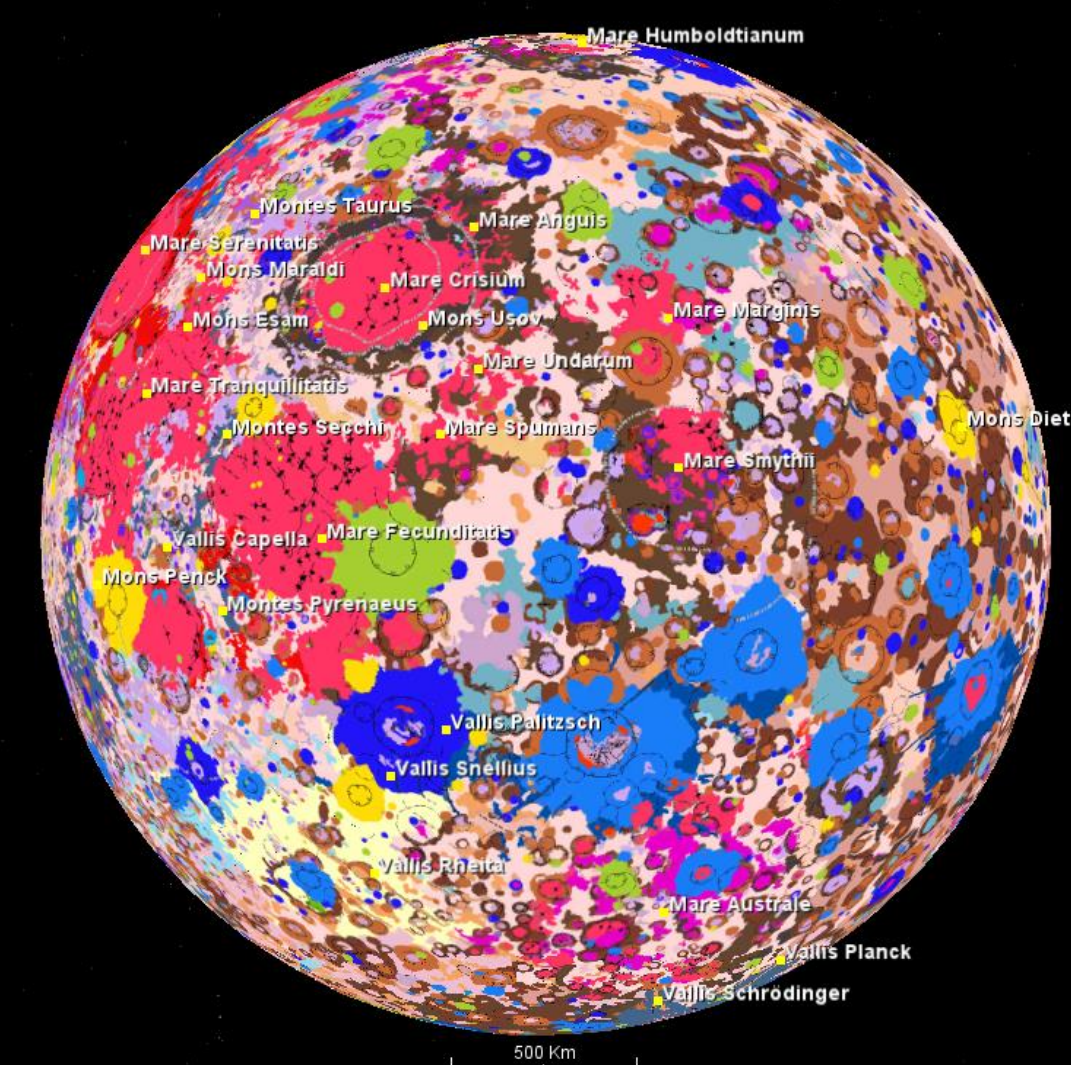


Fig 6. Unified Geologic Map of The Moon – 2020 version

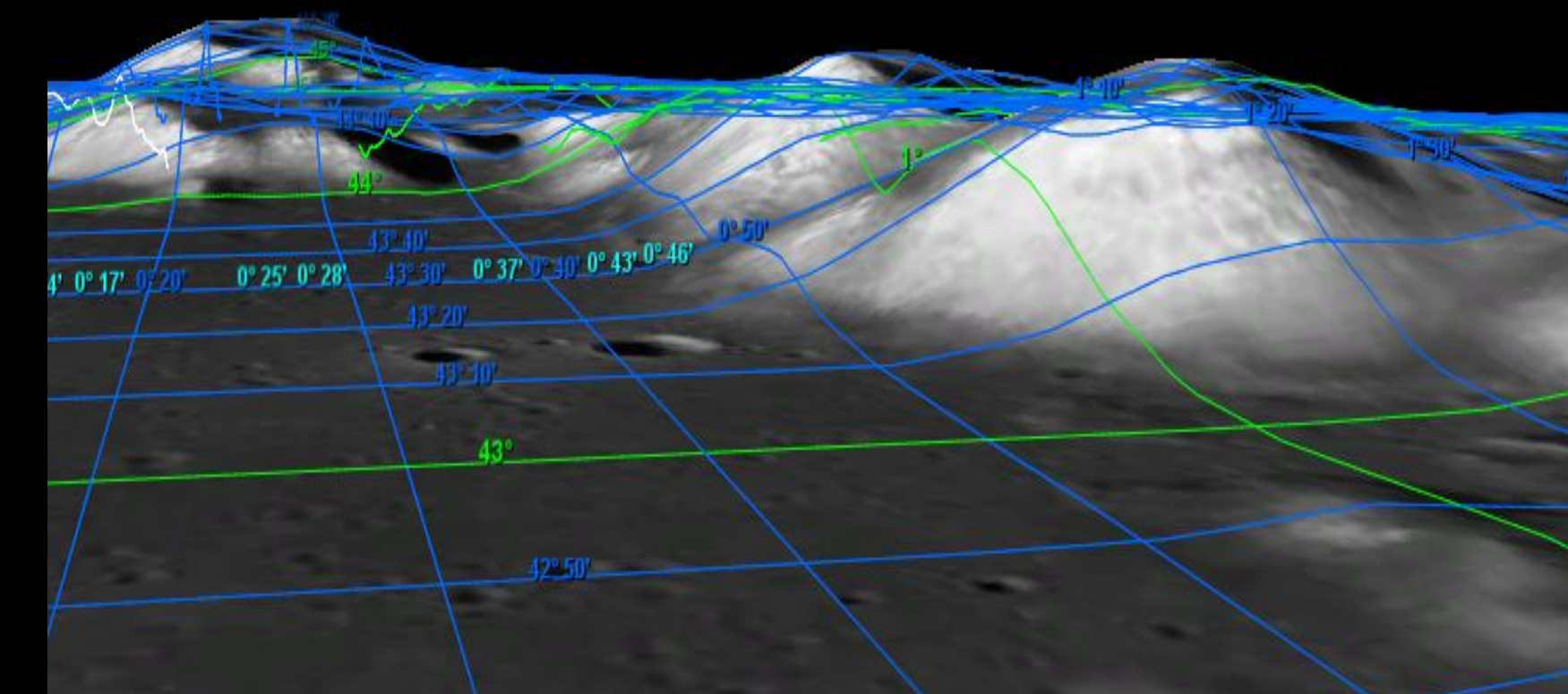


Fig 7. Lat-Lon graticule conforming to mountains

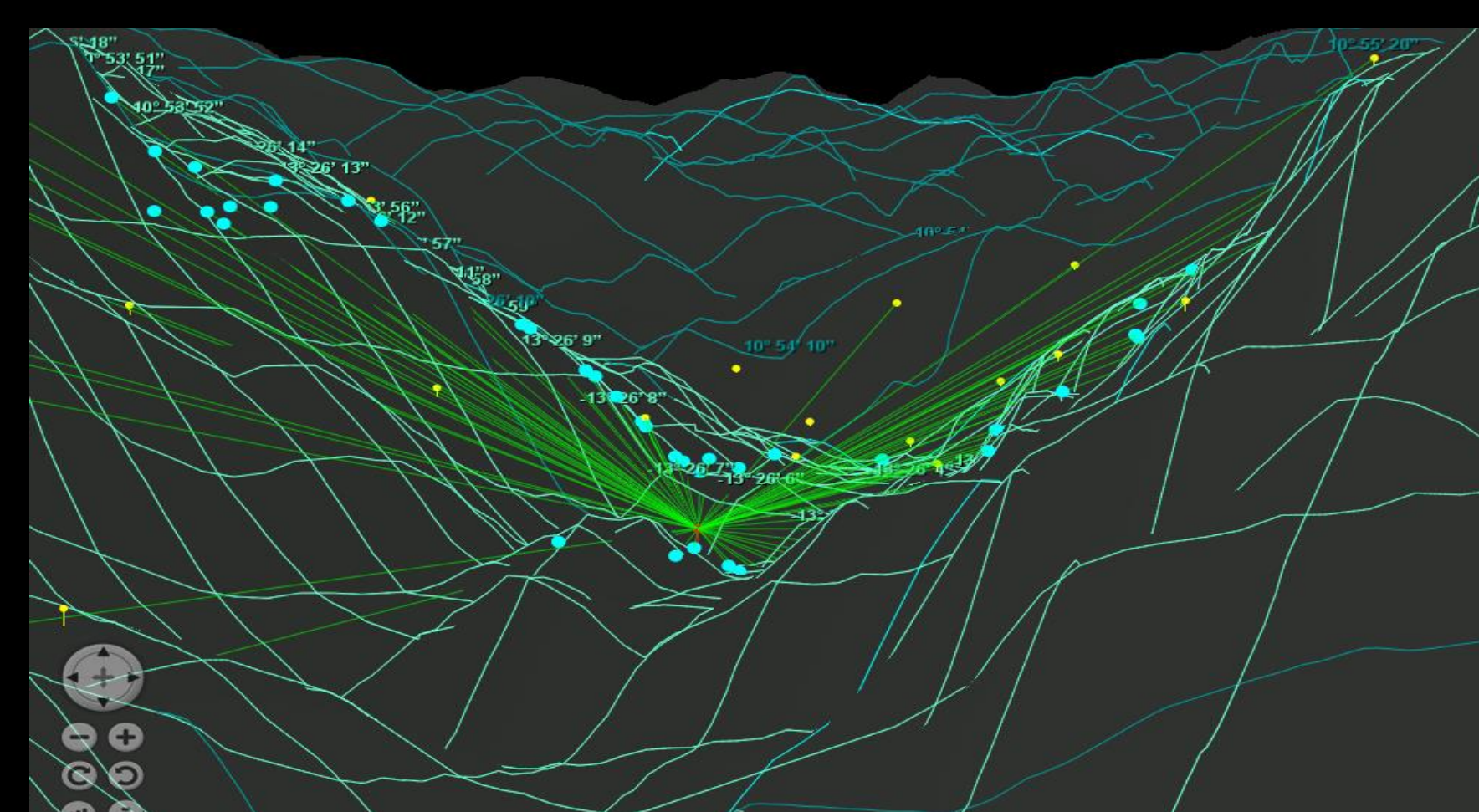


Fig 8. Line of sight analysis inside a crevice

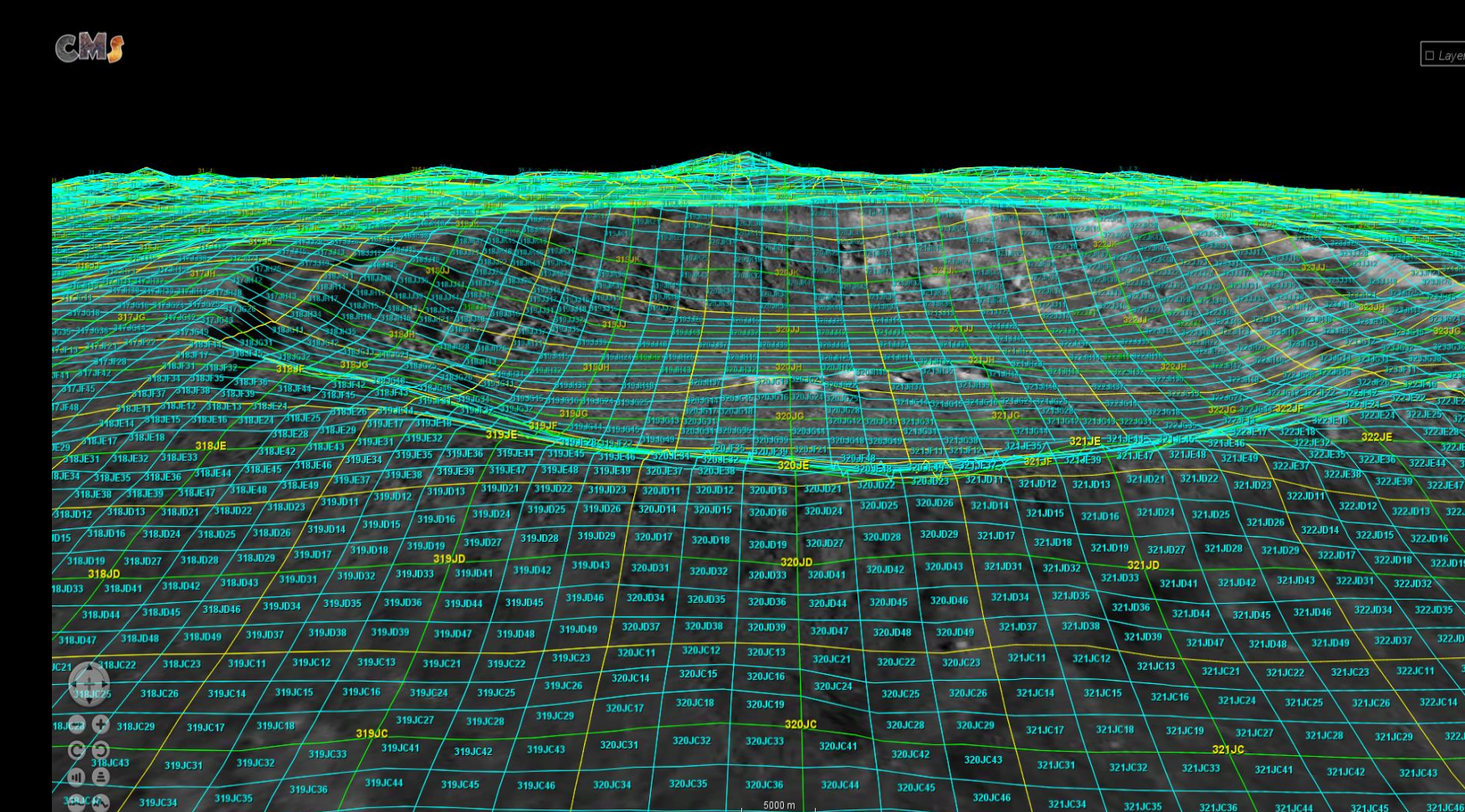


Fig 9. GARS graticule over Copernicus crater

Current Capabilities

- Accurate display of lunar surface and terrain at 100mpp.
- Accurate lunar measuring and calculations (fig. 2).
- Accurate display of lunar place names.
- Ability to display and measure geometric figures.
- Interactive viewing of Apollo landing sites with georeferenced imagery at 20mpp, 3D craft, and annotations (fig. 3).
- Views for stereo, 2D, and 3D.
- Ability to calculate and display lunar terrain profiles (fig. 4).
- Navigation capabilities; view controls, scalebar, and graticules.
- Line of Sight Analysis (fig. 8).

Verification & Validation

- Distance and area calculations from the measurement toolkit and terrain profiler were compared with other lunar applications to ensure accuracy.
- Elevation data was compared with LRO LOLA DEM using QGIS identify features to ensure accuracy of values.
- GDAL (Geospatial Data Abstraction Library) was utilized to analyze datasets.

Future Applications

- Situational and domain awareness for first-person viewing.
- Moon shading/illumination simulation & calculations.
- Subsurface visualization & analysis.
- Search and fly-to functionality.
- Resource assessment.
- Simulation of cislunar satellites.
- Planning capabilities for equipment placements and traverse path optimization.

References

WorldWind, <https://worldwind.arc.nasa.gov/>
USGS, <https://astrogeology.usgs.gov/>
LROC, <http://wms.lroc.asu.edu>

