Terrain Obstruction and Visibility Analysis of Artemis Landing Regions Using Celestial Mapping System. P. Agrawal[1], B.J. McDonald [1,2], A. E. Mora Vargas[1,3], A.F. Zuniga[1], [1]NASA Ames Research Center, Moffett Field, CA 94035-1000, parul.agrawal-1@nasa.gov, [2] ASRC, [3] MEI.

Introduction: NASA's Celestial Mapping System (CMS) [1,2] is a 3D-first design platform built around a unified virtual planetary globe. CMS offers critical capabilities such as equipment planning and placement on the lunar surface, along with 3D line-of-sight (LOS) and visibility analysis—functionalities not available in other state-of-the-art platforms like Lunar QuickMap [3] and Moon Trek [4], which in our knowledge are limited to 2D calculations. Accurate LOS and visibility analysis of lunar terrain is essential for mission planning. This work focuses on terrain analysis of candidate Artemis mission landing regions [5]. ShadowCam images [6] of permanently shadowed regions (PSRs) at these sites are ingested into CMS and combined with Lunar Reconnaissance Orbiter (LRO) Wide Angle Camera (WAC) and Narrow Angle Camera (NAC) layers to generate composite mosaics that reveal both illuminated and shadowed terrain. While similar mosaics were previously reported by Collins et al. [7], they are not publicly available. Therefore, new composite images were generated within CMS to support terrain analysis. Future work will incorporate AI-based automation for data ingestion and mosaic generation [2].

Terrain Obstruction and Visibility Analysis : Figure 1 shows the base WAC imagery of the Nobile Rim 1 region, where the ~2 km PSR is not visible and surrounding areas are also obscured. After integrating ShadowCam data, features within the PSR and adjacent shadowed terrain become visible (Figure 2). CMS includes a LOS tool that evaluates terrain profiles and obstructions to determine visibility from remote observation points. In Figure 2, a 2-meter-tall piece of equipment (white dot) is placed in the Nobile Rim 1 region. LOS rays originating from this point indicate coverage: green lines show clear visibility, while red lines indicate obstructions. Figure 3 presents a viewshed analysis for a 2-meter-tall observer (yellow pin) within the PSR. The yellow region denotes visible terrain, while red areas are obstructed from view.

Summary: This work enables detailed terrain analysis of critical sites near the lunar south pole, providing valuable insights for Artemis mission planning. By integrating high-resolution imagery and advanced visibility tools within CMS, mission planners can better assess landing site conditions, equipment placement, and observational coverage in permanently shadowed regions.

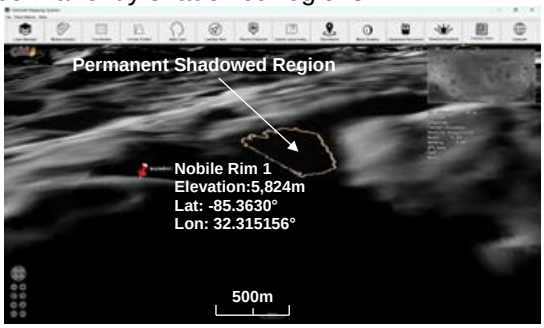

Figure 1: LRO WAC layer at Nobile Rim 1.

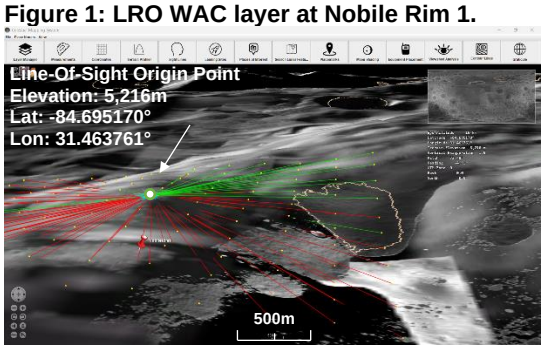

Figure 2: Four Shadow Cam images combined LRO WAC layer. Line of sight analysis for an observer near Nobile Rim 1.

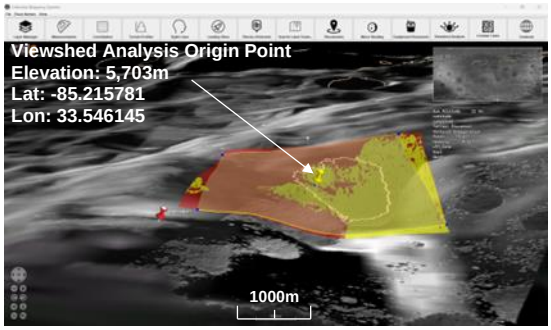

Figure 3: Visibility analysis on the combined mosiac for an observer located inside the PSR. Yellow is visible and red is obstruted zone

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References: [1] https://celestial.arc.nasa.gov [2] Agrawal P. et. al., (2024) LPSC # 2656 [3] E. Malaret et. al. (2025) LPSC abstract # 1657 [4] https://trek.nasa.gov/moon [5] NASA 2022. go.nasa.gov/3ZmPGoH [6] Robinson M. S. et al. (2022) LPSC LIII, #1659 [7] Collins W. M. et. al, (2024) LPSC # 1775.