LUNAR QUICKMAP: YOUR DIGITAL MOON. E. Malaret[1], M.S. Robinson[2], P. Guasqui[1], C. Mauceri[1], A. Battisti[1], and V.A. Malaret[1], [1]Applied Coherent Technology Corp. (**ACT**), 112 Elden Street Suite K, Herndon, Virginia 20170, (malaret@actgate.com), [2] Intuitive Machines (**IM**), Arizona.

Introduction: As lunar missions intensify with the Artemis program and private initiatives, advanced tools are crucial for understanding, exploring, and utilizing lunar resources. **Lunar QuickMap**, a web-based Geographic Information System (GIS) platform, stands at the forefront of this effort, offering an extensive suite of 2D and 3D visualization capabilities and analysis tools of the lunar environment, including the polar regions. Designed for scientists, educators, and commercial stakeholders, **QuickMap** provides a detailed and interactive representation of the Moon, bridging the gap between static data and actionable insights.

Lunar QuickMap (http://lunar.quickmap.io) provides the functionality of a **publicly accessible digital twin** of the Moon, enabling a wide range of lunar exploration and analysis. It continues to evolve as a collaboration between NASA's **LRO** project, the **LROC** team, the Artemis 3 Geology Team, and **ACT** [1,2,3]**.**

Lunar QuickMap has evolved over the last decade into a fully functional digital twin that provides real-time monitoring, predictive simulations, and collaborative mission planning, transforming lunar exploration into a seamless and interactive experience.

Authoritative Lunar Data: Lunar QuickMap primarily utilizes authoritative data sources, including high-resolution images, topographic data, and a wide range of geophysical datasets. The platform integrates data from numerous missions, such as LRO, Clementine, Lunar Orbiter, CH-1/M3, Kaguya, Arecibo, and GRAIL, enabling users to explore geological structures, evaluate landing sites, and analyze illumination conditions with exceptional precision. Advanced tools for time-specific analyses, such as shadow modeling and solar exposure mapping, can further support mission-critical decision-making for space agencies and private enterprises. Most deployed datasets available in **QuickMap** are accessible from NASA's Planetary Data System (PDS). Ephemeris computations are powered by JPL/NAIF/SPICE, ensuring highly accurate positional data. Additionally, the platform allows users to import and overlay custom vector or imagery data on top of existing layers, providing a tailored and versatile environment for lunar exploration and analysis.

Near-real-time data: For mission operations teams, dedicated non-public QuickMap nodes are configured to deliver near-real-time updates of imagery, terrain height, terrain shadows, and derived data products. These nodes can also be tailored to restrict access to approved foundational data layers, ensuring secure, mission-specific planning and operations.

For public-facing QuickMap instances, key datasets are updated promptly upon their release to PDS, ensuring timely availability of the latest information to the broader community.

Support to multiple audiences: Our design philosophy emphasizes usability and versatility, catering to diverse audiences ranging from seasoned lunar scientists to amateur space enthusiasts. The user-friendly interface allows intuitive navigation, while its customizable features provide flexibility for specialized applications.

Data Download and Subsetting: The ability to download and export data further enhances its value for scientific research, educational outreach, and commercial analysis.

A catalyst for innovation and collaboration: QuickMap's role extends beyond exploration. As humanity stands on the cusp of a new era of lunar activity, the tool embodies the convergence of cutting-edge technology and collective ambition. It is not merely a map of the Moon but a portal to its possibilities, empowering users to engage with the lunar environment in unprecedented ways. The potential applications of **QuickMap** are vast and transformative. For researchers, it offers a dynamic environment to study lunar geology, surface composition, and potential resource deposits. Commercial enterprises, including those involved in lunar mining, habitat construction, and communication networks, can use the platform to optimize operational planning and site selection. Educational institutions and content creators can leverage QuickMap to foster engagement and knowledge sharing about the Moon, inspiring future explorers and innovators.

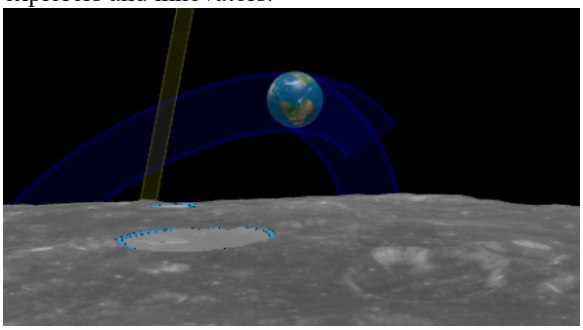

Fig. 1. Using QuickMap as your digital Moon, you can reconstruct the image of the Apollo 8 Earthrise. (https://bit.ly/3DGKk1n). Visible in the image are the two craters named in honor of this event, i.e., 'Anders' Earthrise' and '8 Homeward'.

QuickMap supports a range of use cases critical to Artemis mission planning:

- Landing Site Evaluation: Analyze environmental conditions such as topography, surface temperature, and time-specific illumination.
- Traverse Route Design: Interactively plan and assess routes, considering visibility to the lander, Sun, Earth, and other assets.
- Team Collaboration: Facilitate coordination among public groups, mission controllers, managers, and astronauts.
- Site-Specific Training: Simulate and train for site-specific conditions to enhance mission readiness.
- Rapid visualization using foundation layers.

Some sample QuickMap views are shown below.

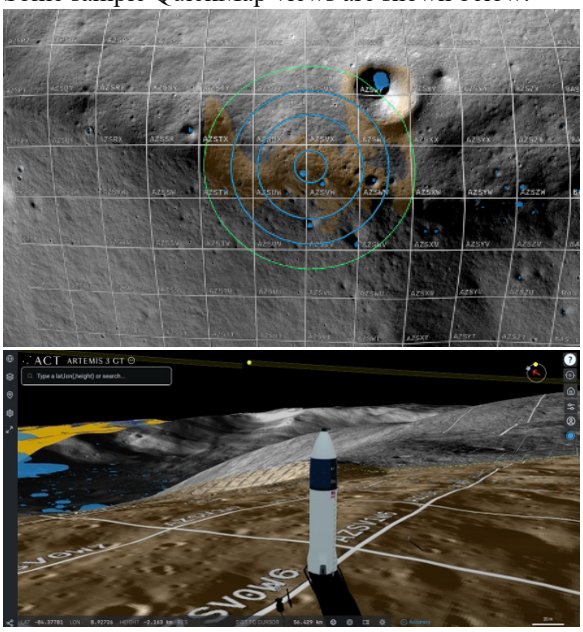

Fig. 2. Nadir and oblique views over Malapert Massif showing lander viewshed layer (in gold), concentric rings from the landing site for quick comparisons, blue patches where permanently shadow regions are located, and an overlay of the Lunar Grid Reference System using Artemis Condensed Coordinates (LGRS/ACC).

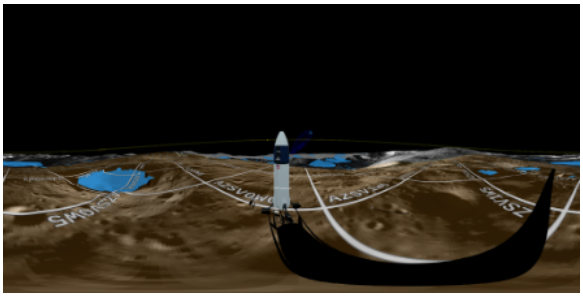

Fig. 3. QuickMap can generate 3D Equirectangular Panorama files, which can be loaded for immersive reality in VR systems like the Apple Vision Pro.

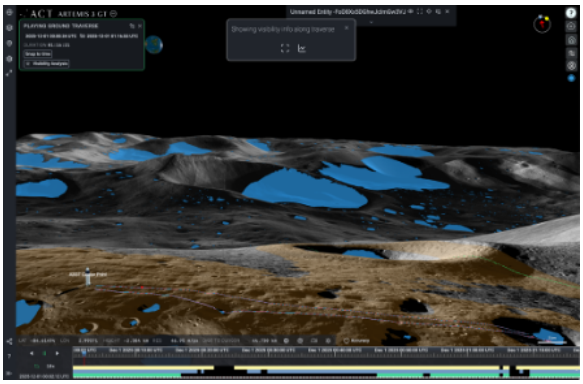

Fig. 4. Composite view over Malapert-Massif showing a sample EVA traverse (starting near the lander). The simulated traverse duration was 1hr 16min with a start time of 2025-12-01T00:00:34.069Z. The horizontal solid bars depict visibility to Sun (YELLOW), Earth (BLUE), and Human-Landing-System (Green).

Conclusion: Lunar QuickMap transforms the Moon into an accessible, analyzable, and interactive domain, supporting humanity's goals of sustainable exploration, scientific discovery, and commercial development. As we prepare to return to the Moon and establish a lasting presence, QuickMap emerges as an indispensable tool—**your digital Moon**.

Beyond the lunar realm, the NASA Moon-to-Mars community can also utilize Mars QuickMap (https://mars.quickmap.io) to support exploration and analysis across planetary boundaries.

References:

[1] Malaret E. et al. (2023) *ELS*, Lunar QuickMap: new mission planning capabilities. [2] Malaret E. et al. (2022) *LPSC*, abstract#2792), [3] Malaret E. et al., (2022) PSIDA, Using QuickMap For Synthetic Lunar Image Modeling (SLIM).