USING LUNAR QUICKMAP TO ASSESS THE VIPER SITE SELECTION. E. Malaret[1] , M.S. Robinson[2], C. Hash[1], 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]Arizona State University, School of Earth and Space Exploration.

Introduction: ACT-REACT-QuickMap™ is a commercial product developed by Applied Coherent Technology Corporation (**ACT**). QuickMap provides an easy-to-use yet powerful web interface for map cartographic products. Designed with the end-user in mind, it offers seamless access to numeric data layers, without the tedium of handling file format details and data ingestion and archive structures.

Mission Proven - QuickMap has directly supported NASA's MESSENGER, MRO/CRISM, and LRO missions. In general, the Science Team can have immediate access to all data for early analysis and cross validation. The public has access to higher level products delivered to the NASA/PDS by the active missions.

Lunar QuickMap is a public facing web tool. It was developed in collaboration with the NASA LRO project, Arizona State University (ASU), and ACT. Lunar QuickMap has similarities to other web based Lunar data viewers, but it differs by exposing features like:

- Interactive visualization of numeric data layers
- Extraction of probes, data profiling, and subcubes
- Supports layer based algebraic expression
- Extraction of cartographic sub cube with all geophysical parameters of interest in the system
- Loading your own data: GeoTIFF/GeoJSON/…
- (beta) Supports both stack and grid view of layers
- (beta) Adv. search/display of LROC/NAC images
- (beta) Synthetic Lunar Image Modeling capabilities, based on QuickMap TerrainShadows 2D&3D

During CY2021, Lunar QuickMap had an average of 1200 unique daily users. The new version of Lunar QuickMap is rich in LRO map products, and also data from many other missions. The user has access to over 1.5 PBytes of lunar data. All the above permits Lunar QuickMap to be used as a decision support tool (**DST**).

VIPER Site Selection: NASA recently announced the Volatiles Investigating Polar Exploration Rover (VIPER) landing site west of Nobile crater[1,2]. The four driving criteria used for site selection were:

- Earth visibility (communication to Earth)
- Sunlight for power and thermal equilibrium
- Potential presence of water
- Terrain that is well-suited for rover navigation

Exploring Nobile with QuickMap: These four selection criteria can be combined into a set of simple expressions using the QuickMap 'Expression Layers Builder" providing an easy to understand color coded parameter map.

Table 1 Actual expressions implemented in QuickMap and color mapping used to create criteria zones. Terrain type variables expose best available DEM in the active region

Criteria Zones	Expression in QuickMap
Sunlight suited for power & thermal regulation Terrain suited for navigation ***Excellent** Earth visibility*	(TerrainPixelScale<=5) **and** (TerrainSlope <= 10) **and** (lavgvis_s_60m >0.5) **and** ***(lavgvis_e_60m >=0.99)***
Sunlight suited for power & thermal regulation Terrain suited for navigation ***Marginal** Earth visibility*	(TerrainPixelScale<=5) **and** (TerrainSlope <= 15) **and** (lavgvis_s_60m >0.5) **and** ***(lavgvis_e_60m >=0.3)***
Terrain **Not-suited** for rover navigation (given available info)	(TerrainSlope > 15) **or** (TerrainPixelScale>5)
Potential presence of water	(TerrainSlope <10) **and** (lavgvis_s_60m ==0)

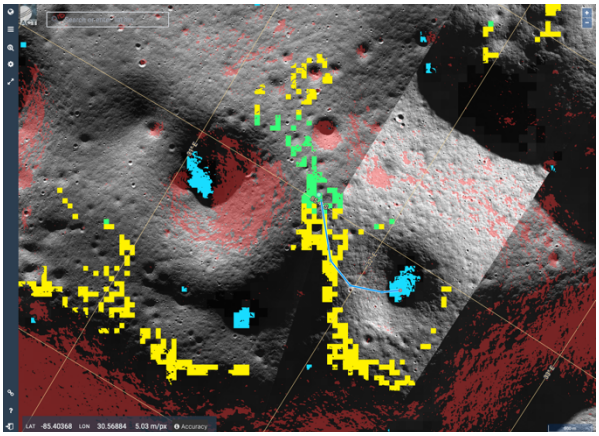

Figure 1 Polar stereographic view to the northwest of the Nobile crater. In this region there is GREEN :: BLUE proximity with no RED obstruction. This makes the search for water simpler. For reference yellow pixels have a resolution of 60 meters.

The right column in the table corresponds to the actual expressions used in QuickMap to highlight the regions of interest. The definitions can be refined and the thresholds can be modified, providing real-time interactive flexibility. From the above color zones definition, optimal conditions arise when there is, *GREEN-BLUE proximity, with no RED obstruction*. Those interesting

conditions can be spot to the north west of the Nobile crater rim, i.e. GREEN-BLUE proximity of less than a kilometer with no RED obstruction.

Figure 1 uses as background image an LROC/NAC image mosaic automatically generated by QuickMap. The above criteria can be applied to other regions in the south pole resulting on some similar GREEN-BLUE proximity, e.g. near Malapert's high peak, see Figure 2.

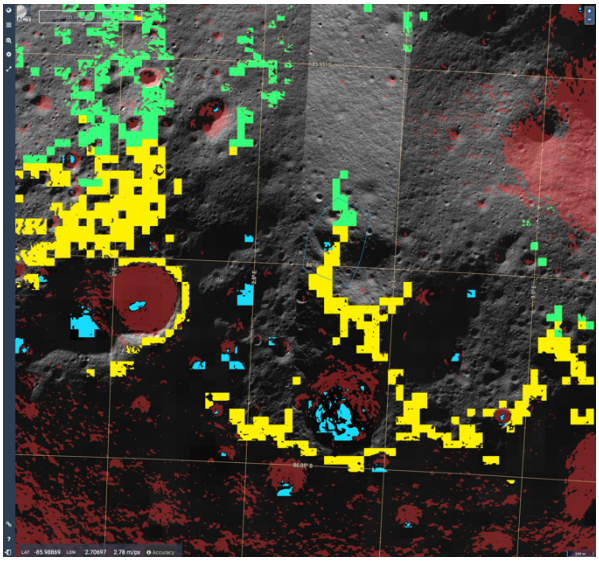

Figure 2 Another example of GREEN-BLUE proximity near Malapert's high peak. For reference yellow pixels have a resolution of 60 meters.

In QuickMap when a user draws a line path, it can apply a search action on it. There is a new tool called "(beta) QTS-2D Light Profile". It allows the extraction of environmental conditions along the profile. Illumination along the profile are computed as a function of time resulting in an intensity image, see Figure 3. Notice that on the extreme right of the image it is dark, indicating the profile entered a permanently shadow region.

The above QuickMap workflow allows a regular user to:

- Validate VIPER teams site selection
- Investigate other regions in a similar fashion.
- Given a target site, perform real time flyovers using high resolution imagery, or using Synthetic Lunar Image modeling, or other basemaps located in the QuickMap server.
- Extract environmental conditions (including lighting) along a surface ground track

This quick assessment was done as an illustration of what can be accomplished using Lunar QuickMap. For operational use the definitions associated with each color zone must be fine-tuned, e.g. the Earth visibility can be recomputed using the specific operational times for VIPER.

Acknowledgments: Lunar QuickMap is a collaboration between NASA's LRO, Arizona State University (ASU), and ACT. Most of the data in the Lunar QuickMap can be accessed at the file level from the Planetary Data System (PDS).

References: [1] Colaprete, A. et al. (2019), AGU Abstract P34B-03. [2] E.Wright, (2021, September 20),"The VIPER Landing Site", Retrieved from https://svs.gsfc.nasa.gov/4937 [2].

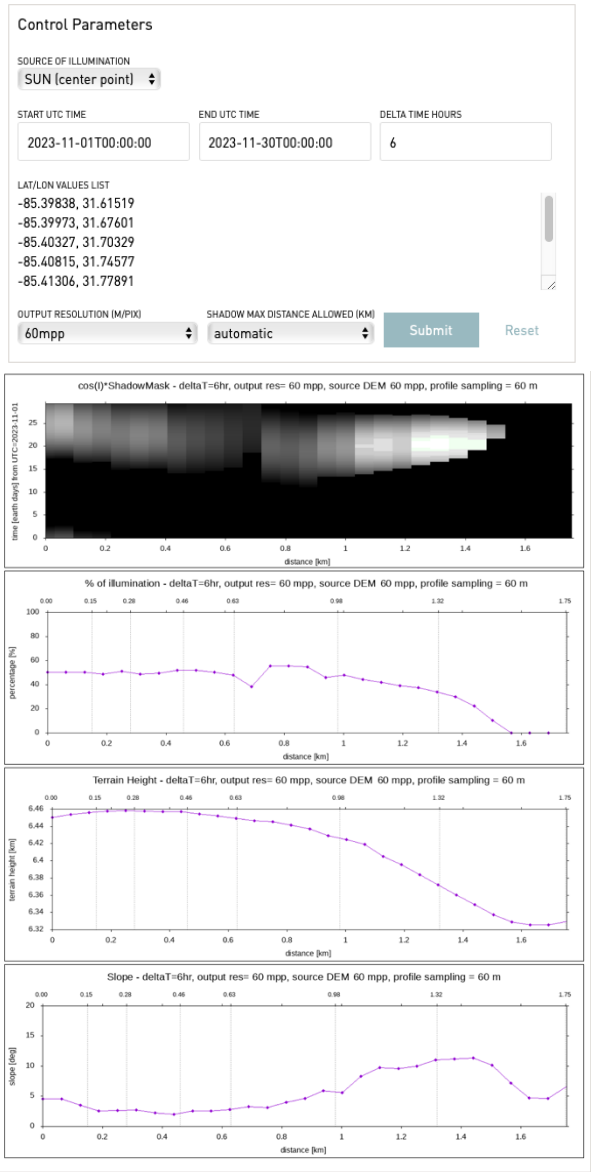

Figure 3 QTS-2D Light Profile tool output, showing extracted environmental parameters along the drawn profile, for the selected times of interest.