ARTEMIS INTERNAL SCIENCE TEAM UPDATE: LUNAR DATA AND DATA PRODUCTS TO SUPPORT SURFACE EXPLORATION AND SITE SELECTION. N. E. Petro[1], S. J. Lawrence[1], M. J. Miller[1,2], and the NASA Artemis Internal Science Team, [1]One NASA, [2]Jacobs/NASA JSC.

Introduction: Artemis crewed missions to the lunar south polar region will require not only intense training by the crews, their support teams, and the scientists supporting the missions [1-3], but also preparation and development of new tools and data products to support the identification of safe landing sites and definition of targets for surface activities [4]. While the overarching science goals of Artemis are described in the Artemis Science Definition Team Report [5], the implementation of the surface missions requires the use of high-fidelity, vetted, data products at every stage of the mission, including post-flight analyses of samples and surface activities.

Artemis will leverage data collected from lunar orbit from no fewer than three modern missions (*e.g.*, LRO, GRAIL, and Chandryaan-1) as well as from upcoming missions such as VIPER other CLPS surface deliveries to the south pole. These landed missions will provide ground truth observations for our remotely sensed observation of the polar regions. These observations will then support site characterization and planning. From those missions we utilize data types ranging from gravity data to high-resolution images to surface topography and surface composition. The value of such data is immense; however, the use of several data products is fraught with challenges with variations in registration quality, intrinsic assumptions of resolution, and other challenges inherent in working with data from multiple sources. As part of the NASA Artemis Internal Science Team, a sub-group focused on the issues of data product generation and use was formed to support the entire Artemis endeavor, from mission planning to implementation to post-mission analyses. Here we describe the candidate Artemis III landing regions as an example of how the datasets are being utilized to support the Artemis effort. Other abstracts submitted to this conference [4, 6] address how the data is being utilized more specifically into the flight process.

Artemis III Candidate Landing Regions: The identification of 13 candidate Artemis III landing regions (Figure 1), down selected from a larger list of 27 regions, required the development of improved 5 meter per pixel topographic data products [7]. The initial list of landing regions, all located poleward of 84° South, were identified based on locations of scientific and exploration interest defined by the science community, including areas of extended illumination [8, 9] and regions with key geologic relationships [10-12]. The 13 Artemis III Landing Regions represent locales that satisfy engineering constraints, including illumination, Earth visibility, slope, and, perhaps most critically, scientific relevance and importance. The initial list of 27 candidate regions, which are clearly listed at the NASA Planetary Geodesy Data Archive, were similarly identified by having high scientific importance (Table 1). These sites become, by their science relevance, targets for future missions.

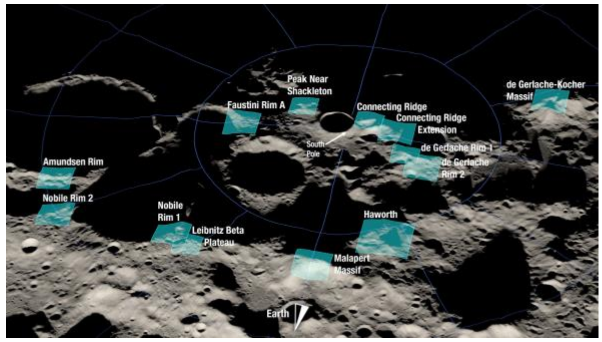

Figure 1. Perspective view of the 13 Candidate Artemis III landing regions. Each region is ~10x10 km in size, centered on features of scientific and exploration interest. [NASA/GSFC/HQ/SVS]

Data Sources: The Lunar Reconnaissance Orbiter (LRO) has been NASA's premier planetary science mission for over a decade. In that time, LRO has delivered over 1.3 Pb of data to the PDS, and in doing so revolutionized our understanding of the Moon. LRO data, as served by the PDS, provides the foundation of our efforts to support Artemis [6]. Here we outline sources of data and their utility in the Artemis enterprise.

Image Data: A significant resource for evaluating landing sites and regions, vis a vis their geologic context, is through the data produced by the Lunar Reconnaissance Orbiter Camera (LROC). The high-resolution images from the LRO Narrow Angle Camera (NAC) and context at the regional scale from the Wide Angle Camera [13] provide the necessary context for evaluating surface features, hazards [14], and illumination conditions [15]. The image scale of the NAC frames at the Artemis sites of interest ranges from sub meter to the meters scale, providing not only geologic context [16] but also the ability to identify sub-pixel sized features [17] based on the movement of shadows cast by the low angle of the sun on the horizon, a feature intrinsic to the polar regions.

Topography: The polar orbit of the LRO mission enables a density of topographic measurements in the polar regions. Recent work [7] has generated updated 5 meter per pixel topographic products for regions of interest within the Artemis exploration zone. These new products allow not only for the characterization of local slopes at the lander scale, but also high-fidelity models of the lighting conditions expected during surface missions. The quality of the LOLA topographic dataset [9] also enables visualizations of the south polar region, which facilitates the characterization of the dynamics of lunar polar lighting conditions.

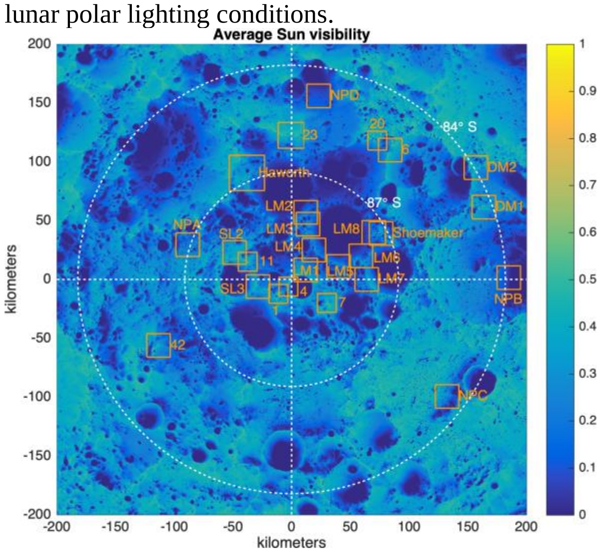

Figure 2. New 5 mpp LOLA topographic maps [7] of areas outlined in orange. These regions cover the initial set of 28 candidate landing regions for Artemis III. The base map is average illumination over 18.6 years [9], note the cluster of sites along crater rims, reflecting the interest in sampling from impacts as well as the density of areas of extended illumination.

Table 1. Example stoplight chart indicating science addressed within groupings of the 27 initial candidate Artemis III sites. It is important to note that site selection will balance science return with site safety, accessibility, and engineering constraints.

Sites	Volatiles	SPA History	Extended Solar Exposure	Chronology
23, SL2, 11, SL3, 1, 4, 7, 42				
NPB, NPC, NPA, NPD				
20, 6, Haworth				
Shoemaker, LM1-8, DM1, DM2				

Composition: We are planning Artemis missions with a robust suite of remotely sensed *compositional* data. Data from multiple missions point to the complex distribution of volatiles in the south polar region [12, 18]. This is but one, albeit critical, component in characterizing a potential Artemis landing site. Recent advances in analyzing remotely sensed lunar data have revealed subtle compositional variations within the Artemis exploration zone [19-21] (Figure 3), which can factor into operation planning, should any landing site be in proximity to such diversity.

Conclusions: Artemis exploration is fundamentally enabled by our modern lunar data. In the Artemis endeavor, we must be confident that the datasets we are using are properly calibrated, georegistered, and consistently projected. The Artemis Internal Science Team's Data Team is prepared to support the data needs of the Artemis effort. The continued use of lunar data by the planetary science community, particularly highlighting the scientific bonanza that awaits us within the Artemis region, is encouraged and needed.

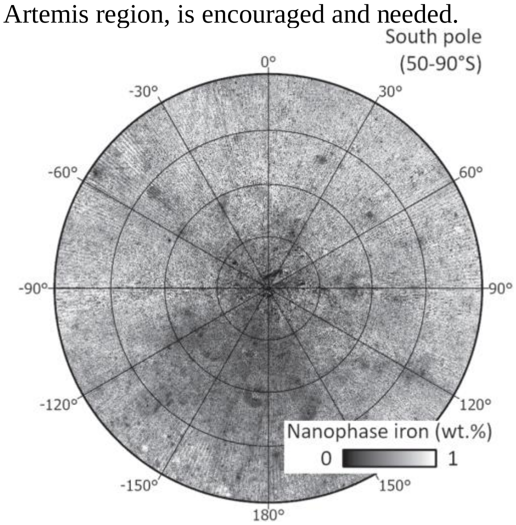

Figure 3. Map of distribution of nanophase iron [20] around the south pole. Such maps (which include maturity, FeO, olivine, ortho- and clino-pyroxene) highlight the subtle yet present variations in regolith composition and properties.

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