A GIS Layer Depicting Proposed Human Landing Sites & Exploration Zones on Mars & Tool to Investigate These.

Kara Latorella[1] and Matthew Tisdale[2], Lavontria Aaron[3], John Leinenveber[3], Joseph Wilson[3], Alyssa Werynski[3], Phyllindia Gant[3]. [1]Space Mission Analysis Branch, NASA Langley (K.A.Latorella@NASA.GOV), [2]Booz-Allen Hamilton, STARSS III contract NASA Langley,). [3] National Institute for Aerospace, NASA Intern.

Introduction: NASA and associated partners have been selecting landing/impact sites since the 1950s. Typically, this selection occurs as a result of accomplished scientists, engineers, and mission analysts from the international community who submit proposals, analyze these with respect to NASA mission objectives, and attend successive workshops wherein these proposals are discussed and rated. Good candidates meet engineering constraints and enable science/resource mission objectives. Golombek et al. [1] document this selection process for the Mars Science Laboratory. More recently, site selection has begun for the next Mars rover – the Mars 2020 Rover [2].

In October 2015, NASA held the first Human Landing Site Selection (HLS2) for Mars workshop. Forty-two presentations were provided. These were discussed in light of NASA's mission constraints and objectives for science and planetary resource acquisition/utilizaition. This workshop invited participants to "begin the conversation about what constitutes a good landing site for future planetary scientists and astrobiologists" [3] by proposing Exploration Zones (EZs). Each EZ contains a Landing Site (LS), a Habitation Site (HS), and Regions of Interest (ROIs) that address science and engineering objectives – all within a 100km traverse from the centralized LS [4] (Figure 1, [5]). Participants characterized EZs' scientific and

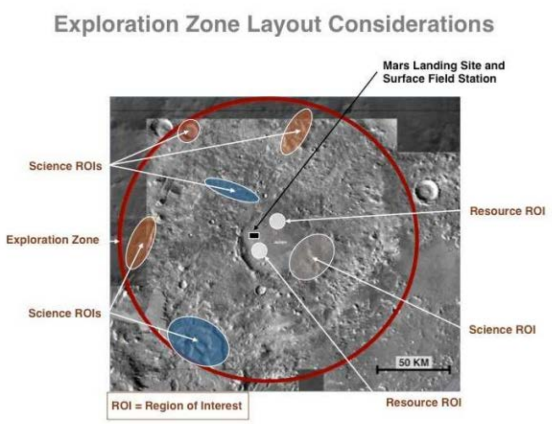

Figure 1. HLS2 Workshop Exploration Zone Example.

engineering benefits in terms of a "rubric" [6] and cited referenced datasets justifying claims. The results of this initial workshop were presentations, video of authors' presentations, and short papers (3 pages). The next steps identified in this workshop were to further discuss the data and analyses required to improve proposed EZs, and consider how the community would best be engaged to continue this conversation [7].

An Integrated GIS Layer & Analysis Environment: The proposals submitted to HLS2 represented a breadth of knowledge from the international scientific and engineering community, and as such contributed an invaluable start to this important conversation. That each proposal was described in separate documents presented an unwieldy dataset for further analysis. HLS2 proposals also contained wide variability that made their data difficult to coalesce. Proposers used different data sources for the same scientific/engineering inferences; used different measurement units, and scales; presented images on different base maps; used different map projections; some used geographical information systems (GIS) to coordinate referenced data, while others simply drew ellipses on base maps, and still others did not include graphical depictions of their proposed site(s). These challenges impede not only NASA's ability to compare and assess contributions, but hinder what could be a valuable collaborative discussion among participants, and the broader scientific/engineering community.

NASA Langley, as part of an internal System Analysis & Concepts Directorate (SACD) and sponsored by the Evolvable Mars Campaign Surface Operations Task, undertook the task of coalescing proposed EZs into a single GIS map layer. The LaRC_Mars_HLS2 Layer depicts all proposed EZs and their constituent LS, HS and ROIs. Each EZ ROI was also associated with rubric characterization data as well as authors' documentation. This effort received generous collaboration from partners in the United States Geological Service (Trent Hare), NASA Ames Research Center (Brian Day), the Jet Propulsion Laboratory (Emily Law) and Arizona State University (Jonathon Hill), who ensured that this effort was compatible with use of data products as produced from others, e.g., USGS data layers (Hare); and other graphical information and viewing software, i.e., MarsTrek (Day & Law); and JMARS (Hill). LaRC_Mars_HLS2 Layer, is available as a shape file that can be imported into standard GIS environments, permitting the assessment of all EZs with a common representation and in consideration of the same contextual data (e.g., geological features, orbital data depicting science-related phenomena). This content will be vetted by proposal authors.

While the LaRC_Mars_HLS2 layer can be used in standard GIS systems, this effort also developed a web-accessible environment, LaRC_MarsGIS_Viewer & Collaboration Tool (LaRC_MarsGIS), based on ESRI Inc. ArcGIS software to support vetting of the layer in a common environment. LaRC_MarsGIS supports display of the LaRC_Mars_HLS2 Layer and permits concurrent display of other Mars data sources, enables map functions (e.g., zoom, pan, measure distance), editing of EZ location and constituent data (by authors), and supports collaboration. A layer file is provided that unifies the depiction and this associated data. The LaRC_MarsGIS also contains ancillary user help documentation and videos. Figures 2 -4 show screenshots from the viewer. The LaRC_MarsGIS will be available for the general public following review of the layer by authors.

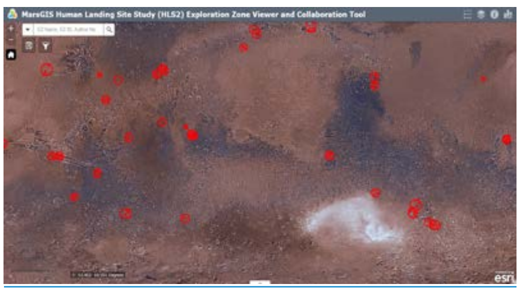

Figure 2. LaRC_Mars_HSL2 layer Overview.

Figure 3. LaRC_Mars_HLS2 EZ information.

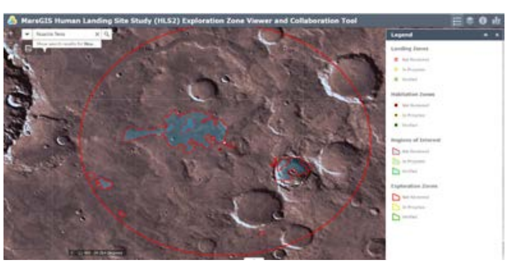

Figure 4. LaRC_Mars_HLS2 author vetting.

Discussion: It was a specific aim of this effort to provide a common representation and common platform to encourage community deliberation for the important task of considering the first human Mars landing site. Group annotation tools support the externalization of judgments and assumptions about information in context, [8] and information tagging facilitate accurate referencing in a common context – especially important for situating group processes that may be asynchronous. Extensions to LaRC_MarsGIS are envisioned to include additional features support collaborative spatial decision support in mission contexts (see [9]).

References:

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