JMARS SOFTWARE DEVELOPMENT FOR NASA'S 2035 HUMAN LANDING SITE ASSESSMENT.

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Introduction: The First Landing Site/Exploration Zone Workshop for Human Missions to the Surface of Mars (Houston, Oct. 2015) reinforced the need for continued collaboration between the science and engineering communities in order to successfully implement a Mars human mission architecture. The most important task is building a community that is well-educated in cross-disciplinary themes, such as Martian surface geology and atmospheric dynamics, in situ resource utilization, surface operations planning, human factor engineering, and crew safety. With this goal in mind, the JMARS (Java Mission-planning for Analysis and Remote Sensing) team at Arizona State University is developing a version of JMARS called "JMARS 2035" specifically tailored towards analyzing potential human landing sites and explorations zones on the Martian surface. This version of JMARS will be available to the public for free on the JMARS website [1] and will feature a variety of new tools and data sets specifically created to characterize both proposed and user-designated human exploration zones. Our goal is to design easy to use JMARS-based tools and datasets, which can create more opportunities for interdisciplinary collaboration, student involvement, and public interest. Feedback and suggestions from the entire human exploration zone community are welcomed during development, and we would especially appreciate collaboration with members of the mining, geological engineering, instrument prototyping, and human spaceflight communities. This feedback will be critical for making the landing site selection process more accessible to teams with diverse backgrounds and specialties.

Background: JMARS is a cross-platform software application developed by the Mars Space Flight Facility (MSFF) at Arizona State University to provide mission planning and data analysis tools for NASA's orbiters, instrument team members, students of all ages, and the general public. JMARS provides access to remote sensing datasets for a number of planetary bodies with a special emphasis on Mars, including image, spectral, and topographic products from THEMIS, MOC, CTX, HiRISE, Viking, HRSC, CRISM, MOLA, TES, GRS/HEND, as well as curated datasets from USGS (such as the Dune Database) and more. JMARS allows its users to conveniently compare, plot, and blend data from multiple sources.

The new JMARS 2035 build will be similar to the JMARS 2020 release created for the Mars 2020 landing site analysis workshops, but will instead be optimized for the human exploration of Mars, as described by NASA's Human Landing Site/Exploration Zone goals [2,3]. Results of the Human Landing Site Selection (HLS2) workshop are included and all proposed exploration zones and regions of interest (ROIs) will be mapped in the interactive JMARS geographic information system environment that the Mars science community has been using for over fifteen years. This will bring awareness of available datasets and analytical techniques to a wider audience and encourage the public to participate in the planning stages of sending humans to Mars. A beta version of JMARS 2035 will be available for demonstration at the JMARS exhibition booth during the 2016 LSPC conference.

New JMARS Tools and Datasets:

Proposed Landing Sites – Additional Mars landing sites are available for display. This includes actual and proposed lander and rover sites. Previously, only MSL and M2020 candidate sites [4] were included.

Proposed 2035 Exploration Zones – Statistics for all Exploration Zones (EZs) and Regions of Interest (ROIs) presented at the first human landing site workshop are available. Statistics include the average, maximum, minimum and standard deviation for: elevation, thermal inertia, slope, albedo, dust index, solar flux, surface temperature, subsurface temperature, potential water ice, and potential hydrated minerals.

Latitude / Elevation / Thermal Inertia Masks – We have incorporated the basic requirements from the human landing site selection supplemental paper [3] as the default values. However, the user may change these limits in order to see which potential sites become flagged or unflagged for varying values of the constraints.

Exploration Zone Circle – Users can create new 100km radius exploration zone circles, for which the statistics described above will be generated.

Science ROIs – Users can create polygonal shapes and the relevant statistics will be generated for the area within the polygon. Users may also categorize the scientific focus of the site (e.g.: aqueous, magnetic, atmosphere, dynamo, volcanism, impact/age dating)

and describe the primary scientific questions the site addresses (e.g.: has high astrobiological potential, provides evidence for/against a shoreline along the dichotomy boundary, constrains timing of Tharsis volcanism, etc.).

Resource ROIs – Users can create polygonal shapes and the statistics outlined above will be generated. This is similar to the Science ROI layer, but with resource categories that were emphasized as high-priority by the first human landing site workshop: water (ice, hydrated minerals, recurring slope lineae), dunes and other building materials, radiation shelter, thermal insulation, wind protection, etc. If water resources are selected, the user will be prompted to estimate the burial depth, deposit thickness, and weight percent of the deposit with references to models used to make those determinations. JMARS will calculate the total resource volume based on these estimates. Our ongoing work aims to incorporate ice thickness models into JMARS.

Additional Maps – JMARS 2035 will include new map layers of recurring slope lineae (RSL) distribution, glacial features, hydrated minerals, and other potential resource-related features. Release of the JMARS 2035 build will be accompanied by a user manual that further explains the layers and rationale, and guides users unfamiliar with Mars science goals to appropriate references.

Acknowledgements: Funding for this work was provided by Arizona State University's School of Earth and Space Exploration (SESE) and the Mars Program Office.

References: [1] https://jmars.asu.edu/ [2] Christensen, P.R.; Engle, E.; Anwar, S.; Dickenshied, S.; Noss, D.; Gorelick, N.; Weiss-Malik, M.; JMARS – A Planetary GIS, AGU 2009, Abstract IN22A-06. [3] Proceedings of the First Landing Site/Exploration Zone Workshop for Human Missions to the Surface of Mars, Houston TX, Oct. 2015; http://www.hou.usra.edu/meetings/explorationzone2015/ [4] JMARS 2020 layer by S. Gyalay and D. Paige.

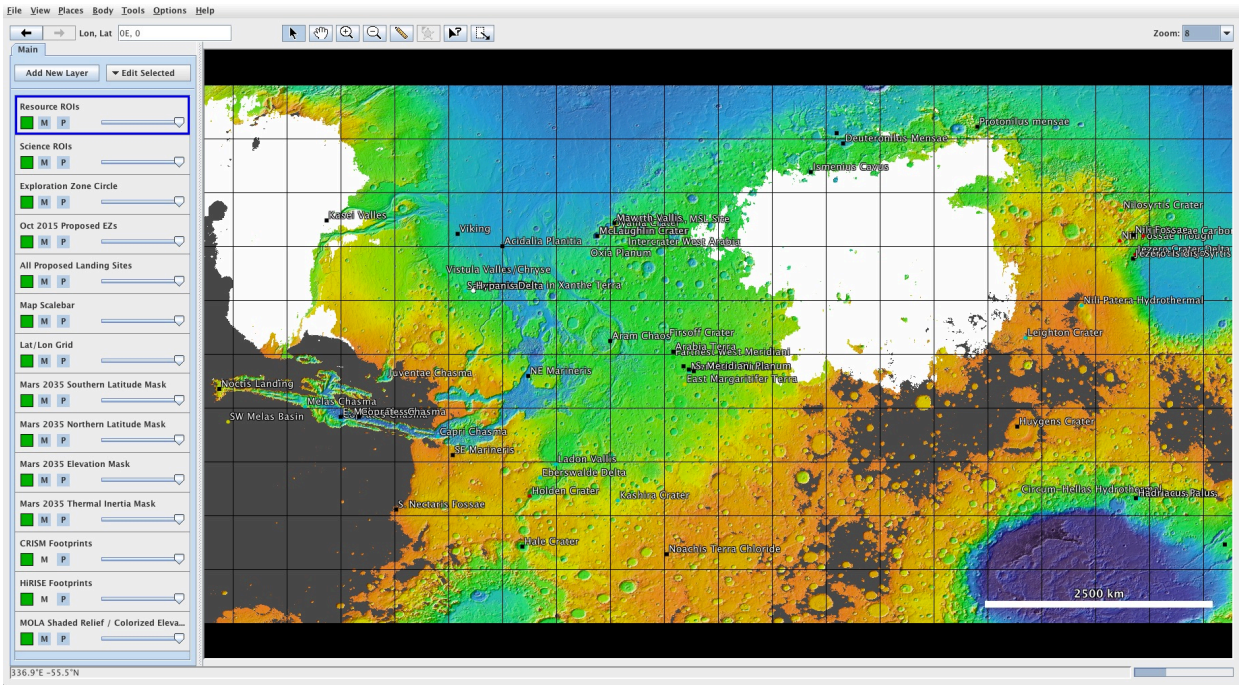

Fig 1: Screenshot of the JMARS 2035 map window and layer manager, with colored MOLA elevation background, elevation mask (grey), thermal inertia mask (white), and potential human landing sites proposed at the First Landing Site/Exploration Zone Workshop for Human Missions to the Surface of Mars [3].