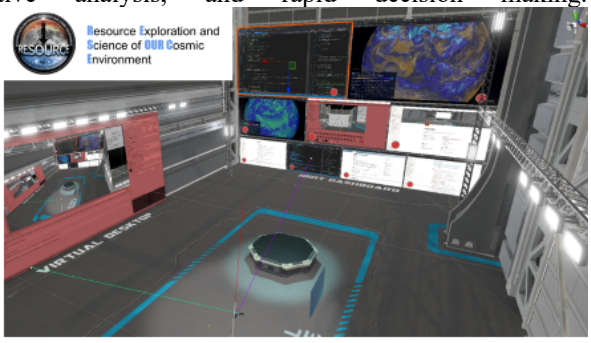
SCIENCE, EXPLORATION, AND PUBLIC ENGAGEMENT FROM NASA's SSERVI RESOURCE (Resource Exploration and Science of OUR Cosmic Environment) PROJECT. Jennifer L. Heldmann[1], Alexander Sehlke[1,2], Matthew C. Deans[1], A. Paz[3], J. Kleinhenz[3,4], A. Deutsch[1,5], Darlene S. S. Lim[1], Anthony Colaprete[1], Richard Elphic[1], Dana Hurley[6], Andy Rivkin[6], Dava Newman[7], J. Shaw[7], Janine Captain[8], Kris Zacny[9], Josh Coyan[10], Anna Wagner[11], Zara Mirmalek[1,2], Alexandra Matiella Novak[6], Deena Khalil[12], and the NASA RESOURCE Team. [1]NASA Ames Research Center, [2]BAER Institute [3]NASA Johnson Space Center, [4]NASA Glenn Research Center, [5]NASA Postdoctoral Program (NPP), [6]Johns Hopkins University / Applied Physics Lab, [7]Massachusetts Institute of Technology, [8]NASA Kennedy Space Center, [9]Honeybee Robotics, [10]U.S. Geological Survey, [11]U.S. Army, Cold Regions Research Environment Laboratory (CRREL), [12]Howard University

Executive Summary: The RESOURCE (Resource Exploration and Science of OUR Cosmic Environment) project is focused on enabling In Situ Resource Utilization (ISRU) near the sites of robotic and/or human missions to enable sustainable and affordable exploration of the SSERVI (Solar System Exploration Research Virtual Institute) Target Bodies. This year RESOURCE has developed a summary of the current state of knowledge regarding lunar polar volatiles and presented these results to the National Academies Committee on Planetary Protection in support of their study on the potential planetary protection issues for lunar exploration. RESOURCE is developing advanced mission capabilities such as a Virtual Mission Simulator System to enable rapid, collaborative operations for lunar resource exploration missions. Hardware testing has been conducted to evaluate potential contaminants released during lunar polar regolith heating. Volatiles and particulates are the two sources of contamination that will affect the requirements of a water cleanup system, and RESOURCE research has identified the requirement for filtration prior to electrolysis for ISRU. RESOURCE also supports development of next-generation planetary drilling systems with integrated scientific instrumentation to change the paradigm regarding subsurface sample handling and measurement on the Moon. RESOURCE is also deeply committed to sustained efforts to engage educators, students, and broadening participation among underrepresented groups, and has partnered with Howard University in Washington, DC to foster minoritized students' interest in STEAMD careers through direct and virtual experiences with NASA Subject Matter Experts (SMEs) of color and the creation of RESOURCE SME storyboards and profiles.

Resource Characterizations: Using our current understanding of the processes that contribute to the distribution of water in lunar PSRs (Permanently Shadowed Regions) and constraints from data on larger spatial scales, we devised multiple potential distributions of water ice. Also, geostatistical analysis techniques across lunar datasets are being developed by leveraging established USGS capabilities to systematically evaluate resource potential.

Advanced Mission Operations Capabilities: The MIT team is developing a suite of virtual tools for data analysis and planning support. The Virtual Mission Simulation System (vMSS) is a VR platform currently under development and testing to determine integration and usability pathways for data display, collaborative analysis, and rapid decision making.



Virtual Mission Simulator System developed at MIT.

ISRU Water Processing: Work supported by RESOURCE at the NASA Johnson Space Center (JSC) is working to process extracted water in an ISRU plant and demonstrate an integrated test of the critical components needed to capture, clean, deionize, and electrolyze water as well as dry the oxygen and hydrogen gas products.

Lunar Drilling Technologies: The RESOURCE team at Honeybee Robotics has been focused on developing advanced downhole technologies to integrate instruments (including a neutron spectrometer and near-infrared spectrometer) into the drilling auger. This advancement would change the paradigm of planetary exploration: instead of bringing samples to an instrument we would be bringing an instrument to the samples.

Public Engagement: The RESOURCE team is working to engage educators, students, and broadening participation among underrepresented groups. We have designed STEAMD resources to cultivate underrepresented students' interest in space science and aerospace careers. Resources include a Doodly video story of a Latinx SME's career path, infographics from the EDIA (Equity, Diversity, Inclusion, Accessibility) Decadal Survey Planetary Science white papers, and connecting ISRU technology development with solution-prototypes that address societal problems.