INTEGRATION OF LOW ALTITUDE AERIAL SYSTEMS DATA INTO FIELD OPERATIONS FOR PLANETARY ANALOG SURFACE EXPLORATION. S.P. Scheidt[1,2,3,4], K.E. Young[3], C,S. Edwards[5], J.M. Hurtado[6], A.D. Horchler[7], T.D. Glotch[8]. [1]Howard University, Washington, DC 20059 (sscheidt77@gmail.com). [2]Planetary Science Institute, Tucson, AZ 85719. [3]Solar System Exploration Division, NASA Goddard Space Flight Center, Greenbelt, MD 20771. [4]Center for Research and Exploration in Space Science and Technology, NASA/GSFC, Greenbelt, MD 20771 [5]Northern Arizona University, Flagstaff, AZ 86001. [6]University of Texas El Paso, El Paso, TX 79968. [7]Astrobotic, Pittsburgh, PA 15222. [8]Stony Brook University, Stony Brook, NY 11794.

Introduction: In the past decade, the value of small uncrewed aerial systems (sUAS) have been demonstrated in several types of terrestrial research field operations. The most typical concept of operations (Con Ops) involves delineating a known area of interest, acquiring aerial images and producing 3D digital terrain models (DTMs) and orthomosaics. sUAS with first-person view capabilities are also valuable for conducting aerial reconnaissance and increasing situation awareness, safety and resource efficiency, especially ahead of boots-on-the-ground human and robotic operations that could have hazardous terrain and need to conduct sampling activities. Where ground operations are not feasible, the sUAS can spearhead primary exploration with engineering solutions such as imaging, spectroscopy, geophysical instrumentation and sampling equipment.

Planetary exploration beyond the Moon has primarily been through satellite remote sensing, landers and mobile rover robotics. As we prepare for the launch of Mars 2020, the Mars Helicopter Technology Demonstration will provide the first example of a planetary sUAS. Dragonfly, a much larger aerial vehicle, will one day explore the surface of Titan. Aerial robotic capabilities, technology development (i.e., flight planning and operations software) and human expertise has reached a critical mass, and sUAS are ubiquitous in the consumer and commercial sectors across the globe. It is critical to transfer this field operations expertise to benefit human space exploration of planetary surfaces. Here we describe RISE2, one of several NASA planetary analog field efforts integrating sUAS with unique payloads.

Fieldwork in Context: The Remote, In Situ, and Synchrotron Studies for Science and Exploration 2 (RISE2) team will address key aspects of exploring and interpreting the surfaces of and samples from the Moon, Near Earth Asteroids, and the moons of Mars. A component of the project is the development of protocols for safe and scientifically productive exploration of those surfaces and maximize the scientific value of samples.

sUAS will play a unique role in our field investigations of the explosive maar crater, Kilbourne Hole (KH), in New Mexico, with a focus on understanding the emplacement of explosive volcanic deposits similar to the Taurus Littrow Valley Apollo 17 landing site on the Moon. The team will focus on maximizing the science productivity of astronauts and mission team members during surface operations. A variety of sUAS, portable handheld and tripod-mounted instruments will be used in the field to characterize the site in both reconnaissance and detailed characterization modes.

During our field campaigns, we will define and compare Con Ops for different approaches that integrate sUAS with field science activities. sUAS will collect broad, consistent baseline image data coverage. Because the high spatial resolution (< 4 cm/pixel) from imaging payloads available and accurate georeferencing by GNSS GPS, these data will provide the best possible geospatial context for data collected during the planned surface exploration simulations. sUAS data allow the application of inferences gained from point instruments to adjacent areas, especially the field team's focus areas located along cliffs that marks the edge of KH. sUAS will provide a perspective of how the ash deposits relate to inaccessible areas on the cliff faces (Fig. 1).

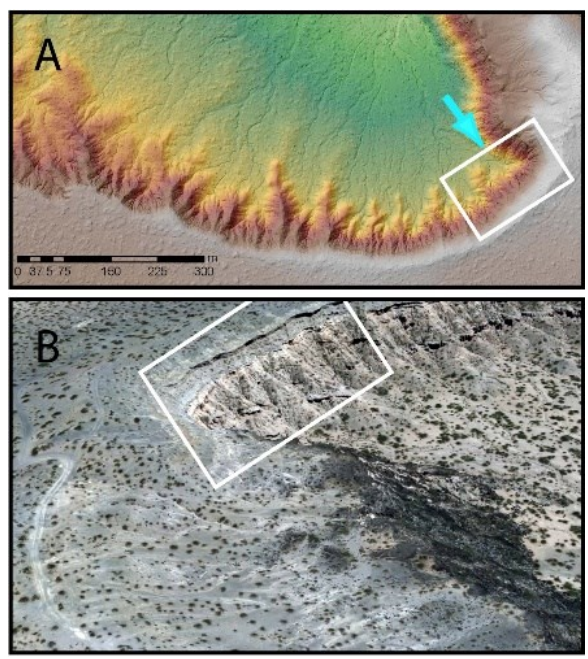

Figure 1. sUAS data of KH, 2017 RIS[4]E 2017 fieldwork. White boxes show pyroclastic deposits in the cliff face under investigation. A) DTM, orthographic view. Blue arrow indicates the viewing direction in B. B) Perspective view using image data projected onto the DTM.