

**CAN AIRBORNE AFRICAN DUST AND MICROORGANISMS CONTAMINATE MARS SPACECRAFT DURING PRELAUNCH PROCESSING AT THE KENNEDY SPACE CENTER, FL?** A. C. Schuerger<sup>1</sup>, B. J. Tench<sup>1</sup>, D. W. Griffin<sup>2</sup>, and D. S. Smith<sup>3</sup>, <sup>1</sup>Univ. of Florida, 505 Odyssey Way, Exploration Park, N. Merritt Island, FL 32953, email: [schuerger@ufl.edu](mailto:schuerger@ufl.edu); <sup>2</sup>USGS, 600 4<sup>th</sup> St. South, St. Petersburg, FL 33701, [dgriffin@usgs.gov](mailto:dgriffin@usgs.gov); <sup>3</sup>NASA Ames Research Center, M/S SCR-261-3, Box 1, Moffett Field, CA 94035; [david.j.smith-3@nasa.gov](mailto:david.j.smith-3@nasa.gov).

**Introduction:** Planetary spacecraft assembled in cleanrooms at the Kennedy Space Center (KSC), FL are prepared under strict cleanroom conditions to mitigate the risks of forward contamination of the target planetary bodies being explored. Deserts are the primary sources of mobilized aerosols on Earth (e.g., the Sahara and Sahel regions of North Africa; and the Gobi and Taklamakan deserts of Asia). Current estimates for the quantities of desert dusts that make regional or global airborne migrations are between 2 to 5 billion metric tons per year [1]. Of this amount, 50 million metric tons of African dust settles out over Florida lands and waters each year [2]. The peak season for African dust to hit Florida is August thru September, and dust storms from Africa generally take between 3 and 5 days to reach Florida [3].

**Methods.** In order to characterize the microbial diversity associated with African dust transported to Florida, a wing-mounted dust collection system called the Dust Atmospheric Recovery Technology (DART) was developed (Fig.1). DART was mounted under the wings of an F104 Starfighter jet (Fig. 1, top; Starfighters Aerospace, KSC) for two test flights in December 2013, and on additional science flights on a T6 Texan (Fig. 1, bottom; Warbird Adventures, Inc., Kissimmee, FL) in November 2014. Most flights on both aircraft transected the air column over KSC. The aerosols and associated microorganisms were collected on 47 mm diameter 0.45  $\mu$ m nylon filters mounted in holders plumbed to four independently controlled filtration units. A science mission specialist flew in all flights and would actuate the filtration units as required for optimizing the sampling process. Filters were then plated on R2A agar for enumeration, isolation, and DNA sequencing of all culturable bacteria and fungi. Metagenomic analyses for non-culturable species will be conducted in future surveys.

**Results.** The DART filtration systems (#4) exhibit flow rates from 25-142 L/min depending on the pore size and brand of filters used. Higher flow rates are directly correlated to increased air speed, and are inversely correlated to increased altitude. Filtration units can be turned on individually for specific science objectives. The DART dust sampler has performed nominally up to 7600 m, 0.92 Mach, and 3.5 +G's.

During initial test flights on the F104 and T6 aircraft, 5 of 8 genera of fungi recovered from the lower atmosphere over KSC contained bacteria at densities



Fig. 1. DART mounted on a F104 jet (top) and a T6 Texan (bottom) over-flying KSC.

between 0 and 25 cfu's/filter (i.e., 30-60 min collection times at 100 L/min). In contrast, greater numbers of fungi were recovered per sampling transect on filters with a range of <15 to  $1.84 \times 10^3$  cfu's/sample. Diversity of fungi included species in the genera: *Acremonium*, *Aspergillus*, *Cladosporium*, *Curvularia*, *Eupenicillium*, *Fusarium*, *Penicillium*, and *Pestalotiopsis*. The 16S and ITS sequencing is ongoing for bacteria and fungi collected during these flights.

**Discussion.** During the peak African dust season, aerosols over KSC are likely to increase by 2 to 5 fold [2], and may constitute a significant source of microbial contamination for planetary spacecraft. If confirmed, spacecraft handling or transport protocols may have to be modified during African dust seasons over FL to constrain the microbial diversity on spacecraft. Future research is required to track the microbial diversity in the bulk atmosphere over KSC during African dust storms and correlate results to changes observed in spacecraft assembly facilities (SAF).

**References:** [1] Perkins, S., 2001, *Science News*, 160, 200-201. [2] Prospero, J. M., 1999, *J. Geophys. Res.*, 104, 15,917-15,927. [3] Griffin, D.W., *Clinical Microbiol. Rev.*, *Aerobiologia*, 22, 459-477.