COASTAL CALIFORNIA'S FOG AS A UNIQUE HABITABLE NICHE: DESIGN FOR AUTONOMOUS SAMPLING AND PRELIMINARY AEROBIOLOGICAL CHARACTERIZATION. Diana Gentry[1], Dillon Arismendi[2], Cynthia Ouandji[3], Marcello Guarro[4], Isabella Demachkie[4], Ewan Crosbie[5,6], Hossein Dadashazar[7], Alex B. MacDonald[7], Zhen Wang[7], Armin Sorooshian[7], Haflidi Jonsson[8], and Robert Dahlgren[9]. [1]NASA Ames Research Center, Biospheric Science Branch, MS 245-4, Moffett Field, CA 94035 USA diana.gentry@nasa.gov [2]City College of San Francisco, San Francisco, CA, USA [3]San José State University, Biomedical, Chemical, & Materials Engineering, San José, CA, USA [4]University of California, Santa Cruz, Santa Cruz, CA, USA [5]NASA Langley Research Center, Hampton, VA, USA [6]Universities Space Research Association, Columbia, MD [7]University of Arizona, Tucson, AZ, USA [8]Naval Postgraduate School, Monterey, CA, USA [9]California State University, Monterey Bay, School of Natural Sciences.

Introduction: Just as on the land or in the ocean, atmospheric regions may be more or less hospitable to life. The aerobiosphere, or collection of living things in Earth's atmosphere, is poorly understood due to the small number and *ad hoc* nature of samples studied. However, we know viable airborne microbes are found throughout the troposphere and into the stratosphere[1]. They play important roles, such as providing cloud condensation nuclei, but it is unknown if there are airborne populations that metabolize or reproduce[2]. There is now solid evidence that airborne microorganisms are common and widespread, and that at least some local atmospheric regions provide the environment necessary for growth and reproduction[3]. Knowing the distribution of such microorganisms, how their activity can alter water, carbon, and other geochemical cycles, and their underlying climatic and ecological dynamics is key to developing criteria for planetary habitability, particularly for potential habitats with wet atmospheres but little stable surface water.

Coastal California has regular, dense fog known to play a major transport role in the local ecosystem. In addition to the significant local (< 1 km) georgraphical variation in typical fog occurrence and persistence, previous ground and near-ground aerobiological studies have typically found that changes in height above surface of as little as a few meters can yield significant differences in typical concentrations, populations and residence times. No single current sampling platform (ground-based impactors, towers, balloons, aircraft) is capable of accessing all of these regions of interest.

Design: A novel passive fog and cloud water sampler, consisting of a lightweight passive impactor suspended from autonomous aerial vehicles (UAVs), is being developed to allow 4D point sampling within a single fog bank, allowing closer study of small-scale (< 100 m) system dynamics. Fog and cloud droplet water samples from low-altitude aircraft flights in nearby coastal waters were collected and assayed to estimate the required sample volumes, flight times, and sensitivity thresholds of the system under design.

Method: 125 cloud water samples were collected from approximately 20 flights of the Center for Interdisciplinary Remotely Piloted Aircraft Studies (CIRPAS) instrumented Twin Otter, equipped with a sampling tube collector, occurring between 18 July and 15 August 2016 at low altitudes off the central California coast. The collector was flushed first with 70% ethanol, then with sterile DI water, between sampling regions. Collected volumes ranged from ~100 µL to 12 mL, typically 3-4 mL. All samples were diluted serially (10^0, 10^{-1}, 10^{-2}) and the dilutions plated on two different types of agar, Plate Count Agar (PCA), a nutrient-dense medium, and R-2A agar, a nutrient-sparse medium which allows slower-growing microorganisms to thrive. Plates were incubated at room temperature and counted when colonies first appeared and again at 2 weeks.

Results and Conclusions: Preliminary results from seven flights (51 samples) are consistent with generally reported colony-forming unit (CFU) values for terrestrial fog water (*e.g.*, [4]). The PCA assay had 6 samples with no growth, with the remainder ranging from 400 to 125,000 CFU/mL. R-2A results were 9 no growth with remainder between 700 and 130,000 CFU/mL. PCA and R-2A mean and median counts were not significantly different at $\alpha = 0.05$, although this varied between flights, and observationally, the R-2A plates had more pigmented colonies. CFU counts from the majority of flights were not different from each other in mean at the same level of significance, but about half differed in median, indicating differences in underlying distribution.

These results validate the presence of viable microorganisms in coastal California fog at levels that should be easily detectable by our sampling system. The indicated distribution differences underscore the need for small-scale, long-term sampling surveys. Future planned work includes ion chromatography for limiting nutrients, ATP quantification, and qPCR for several microbial classes of interest.

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