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NF1676 TN 61207 - AGU Fall Meeting 2018

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Title:
An Improved UAV-Based Fog Collector for Local-Scale Aerobiological Sampling

Abstract:
The use of unmanned air vehicles (UAVs) to passively collect fog for microbiological analysis is being investigated at NASA Ames, contributing to our understanding of the dynamics and limits of the biosphere. Current improvements to a preliminary payload design include physically modifying the mesh of the passive impactor collection unit (PICU) to increase fog-capture efficiency and a quick- mounting system to improve sample turnaround and contamination control.

Increasing the water-capture efficiency of the PICU involved changing the surface roughness of the polypropylene mesh by abrasive sanding. Four scale models of the PICU were created, with three of those models sanded with 80-, 150-, and 240-grit sand paper for a minimum of thirty seconds on each side. Each mesh was individually tested in a fog-simulation chamber to measure collection efficiency. Tests showed that sanding the mesh will increase the water-capture efficiency by at least 3-fold for the 150- and 240-grit. Next steps are to determine the scaling laws and minimum amount of exposure time as a function of the fog density, to acquire enough microorganisms for analysis; a light-weight ground module for the PICU has been developed to allow rapid, easy field testing.

Developing a mounting system that will ensure sterile deployment, as well as prompt changes of PICUs, for collection of fog water, utilized computational fluid dynamics (CFD) for the UAV to ensure that the location of the impactors will not be contaminated by particulates in the UAV downwash. The original design allowed the impactors to remain within sterile packaging until mounted on the UAV but did not address the concerns of contamination from aerodynamic ground effects and particulate lofting during takeoff. Design for a raised launch pad would allow for the sterile PICU to be attached to UAV and launched from outside the region of projected particulate lofting. California coastal sites have been scouted for appropriate testing locations.

The improvements to the PICU design and operations will allow for multiple sampling points within a single fog event. The returned fog samples will undergo ion chromatography, qPCR, ATP quantification, and other tests to characterize microbial species and relevant biochemistry.