

Design and Development of A Small Instrument To Investigate Airborne Aerosols

In support of the US Army Research Laboratory

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Conducting Marine Mammal Study Ship Testing

NOAA is planning an extensive UAS based marine mammal survey through our NOAA Cooperative Institute for Arctic Research (CIFAR), as part of their UAS Arctic Testbed program.

UAS sea trials now

Operation scheduled spring 2009



University of Alaska's Unmanned Aircraft Program

The University is focusing on **evaluating** unmanned system **operations** and identifying hurdles for **a new capability** to become a **financially feasible enterprise**.

Providing Unique Professional Flight Services for the
Research & Development Community

- ✓ Civil Government
- ✓ Science Community
- ✓ Industry

Three Directions Within Our Program

Safe Airspace Integration

AFS's Air Attack
5,000 ft MSL

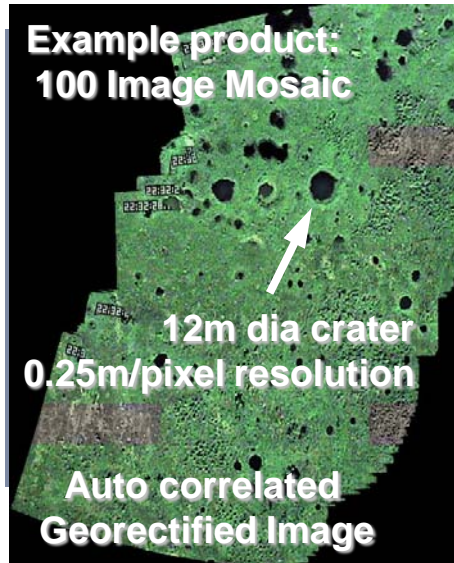


UAF's Insight UAS
3,500 ft MSL



New Payloads and Processing

Example product:
100 Image Mosaic



Enhancement Testing in Field Operations

CGC Healy
WAG-20

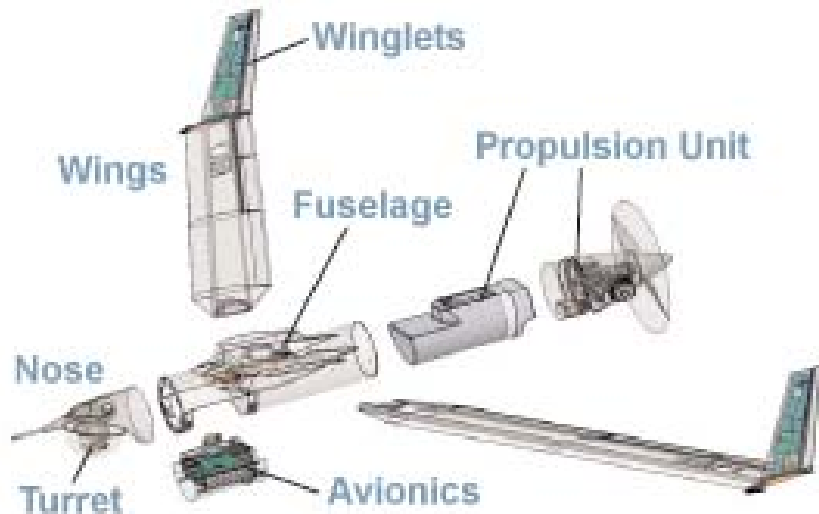


The University's Insight UAS Hardware

The Insight A-20 (aka ScanEagle)

Specifications

- 10.2 ft Wing Span
- 3.9 ft Length
- 26.5 lb Empty Weight
- 12.4 lb Payload and Fuel Load
- 44 lb Max Take-off Weight
- 20+ hr Endurance



Portable Control Station



Why Study Aerosols?

- **Cause a variety of adverse human health impacts including:**
 - increased morbidity (e.g. asthma, chronic obstructive pulmonary disorder, etc.)
 - premature mortality
- **Degrade visibility**
- **Provide intelligence about activities**
- **Contain both natural and human-caused:**
 - biological components such as bacteria and viruses
 - inorganic components such as heavy metals or radioactive species

Needed Aerosol Information

Aerosols need to be characterized by:

- **Size**
 - How big is it?
 - How far can it transport?
 - Where will it deposit in the lungs or environment?
- **Concentration**
 - How much is there?
- **Chemical composition**
 - What is it made of?
 - Where did it come from?
- **Biological activity**
 - What can it infect?

Needs are both spatial and temporal with high resolution

Sampling in AOs

The aerosol concentrations observed in many military AOs are higher than those experienced in the U.S. and known to cause adverse human health impacts



Proof of Concept Iraq Deployment

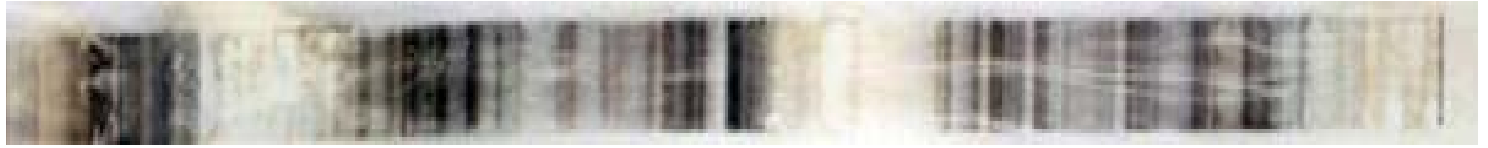
- **Two stationary DRUM samplers**
- **Operated by a US Army RDECOM FAST team**
- **Data provided to Army and Navy medical and environmental health professionals**



Baghdad Aerosols February-March vs. May-June

Feb-March

0.75 to 0.56



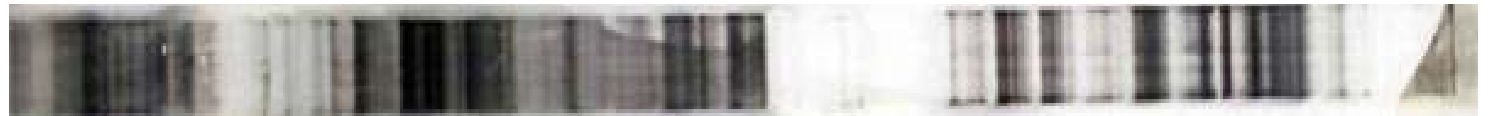
0.56 to 0.34



0.34 to 0.26

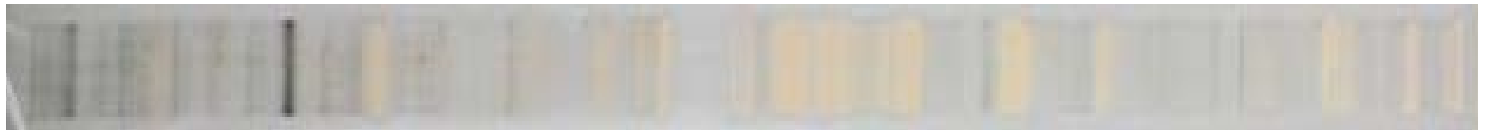


0.26 to 0.09

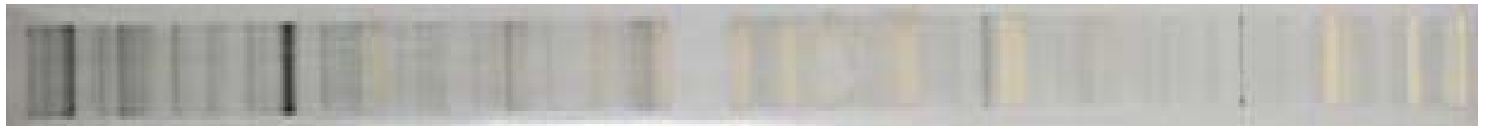


May-June

0.75 to 0.56



0.56 to 0.34



0.34 to 0.26



0.26 to 0.09



**Units in
micrometers.**

***Ex Post Facto* Biological Analyses**



- **Developing techniques for determining the amount of exposure the Warfighter receives to specific biological species such as fungi, viruses and bacteria**
- **Already being used on samples collected in the AO**
 - **For example: No anthrax or bubonic plague was seen in the first set of Iraq samples analyzed**

Real-Time Biological Analyses



Real-time analysis for multiple specific threat agents such as anthrax and for total biological activity is being developed for use in the UAS-mounted aerosol sampler

UAS Aerosol Sampling

- **Developing a lightweight, rugged, and easily-deployable instrumentation for characterizing aerosols over large areas**
- **Planned deployment on the Insitu Insight system (a.k.a. a Boeing ScanEagle)**
- **Collects real-time information on:**
 - aerosol concentration
 - radiological activity
 - biological activity



Advantages of UAS Aerosol Sampling



- **Spatially and temporally map aerosol composition and concentration**
- **Establish baseline aerosol characteristics and statistics by flying the same path multiple times and under multiple meteorological and emission situations**
- **Map plumes from known and unknown sources**
- **Examine changes in source emissions over time**
- **Provide a tactical level, rapid response of aerosol collection equipment to a suspected release of potentially hazardous compounds**
- **Reduce the exposure of personnel to hazardous compounds by remotely collecting samples**

Climate Modeling Payload

Climate modelers need repeated measurements at defined points
Presently there are few methods to collect this data in the Arctic

Joint
University of Alaska
University of Colorado
Project

The payload needs are:

1. Meteorological information
 - + wind speed and direction,
 - + relative humidity,
 - + pressure,
 - + temperatureas a function of altitude.
2. Incoming and reflected spectral radiation information

Miniature dropsondes can collect the necessary meteorological data

Summary of UAF Defense-Related Aerosol Efforts

UAF is:

- **Developing next generation instrumentation capable of aerosol characterization with high temporal resolution in an area of operations**
- **Developing analytical protocols suitable for the characterization of biological aerosols within these samplers**
- **Demonstrating the effectiveness of the new instrumentation for many applications, including environmental and human health studies**

Questions?

