ARM Aerial Facility: UAS Capability Development

Beat Schmid, Fan Mei, Pete Carroll, John Hubbe, Mike Hubbell, Albert Mendoza - PNNL

ARM CLIMATE RESEARCH FACILITY

DataHawk Small UAS

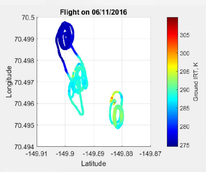
Developed by Dale Lawrence, Univ. Colorado

- Wingspan: 1 m
- Weight: ~700 g
- Payload: ~ 80 g
- Electric propulsion
- Duration: up to 60 min
- Rear folding propeller
- 11-16 m/s airspeed
- Power: LiPo battery
- Cost: ~ $800
- Airframe: EPP foam
- Autopilot: custom (CUPIC)
- Autonomous flight control with user supervision, real time changes in flight profile
- Flight termination mode prevents fly-away and conflict with other air traffic

Small, low-cost, safe, easy to operate,high-resolution sensing *system*

DataHawk sUAS (PNNL Operations)

- October 2015: Training near Boulder, CO
- December 2015: 4 Units delivered to PNNL
- March and May 2016: PNNL flights in Pendleton, OR UAS Range
- June-Aug 2016: 6 weeks of flights at Oliktok Point, AK
- May, Aug, Oct 2017: 4 weeks of flights at Oliktok Point, AK



DataHawk Sensors

Sensors	Status	Comments
Slow temperature and humidity sensor	Calibrated at CU (Univ. of Colorado) Compared with hand-held temperature sensor	Need routine calibration procedure
Cold wire 100 Hz temperature sensor	Calibrated against the slow T/RH sensor	Will be replaced by 3-wire probe during FY17.
Upward and downward looking thermopile sensors	Calibrated using temperature controlled water bath.	Developing routine for ground check
Pitot tube (pressure measurement)	Calibrated at CU	Need additional wind reconstruction.
Platform position/velocity/attitude	Characterized at CU	Involved in improved wind reconstruction

Future plan:

1. Collaborate with Prof. Lawrence's group at CU for wind reconstruction.
2. Improve temperature sensor calibration.

Group 3 UAS "ArcticShark"

Developed by Navmar Applied Sciences Corp

- Wingspan: 6.5 m
- Length: 4.4 m
- Empty Weight: 194 Kg
- Max Gross Take-off Weight: 284 Kg
- Max Payload: 45.5 Kg
- Payload Power: 2,500 W
- 4 Underwing Hardpoints
- Max Altitude: 4.6 - 5.5 Km
- Endurance: 10-12 hours
- Iridium SatCom (Beyond-Line of Sight Ops)

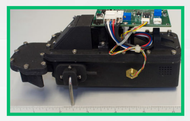
Timeline

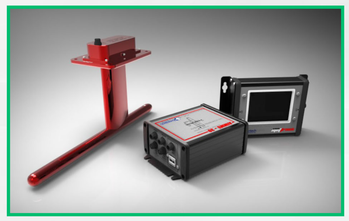
ArcticShark UAS (updated 1/24/2017)

Milestone	Date
Maintenance technician training, Rome NY	Nov/Dec 2016
Pilot training NASC, Rome, NY	Nov/Dec 2016
Delivery of ArcticShark, Pendleton, OR	Feb 2017
Complete acceptance test flights, Pendleton, OR	Mar 2017
Complete pilot training, Pendleton, OR	Mar 2017
Additional training flights, Pendleton, OR	Jun & Aug 2017
Complete integration of initial payload, PNNL	Aug 2017
Engineering/test flights with small payload, Pendleton, OR	Sep - Nov 2017
Complete integration of more complete payload, PNNL	Apr 2018
Science/engineering flights, Oliktok, AK	May & Aug 2018
ArcticShark available for missions proposed, Oliktok, AK	May - Aug 2019

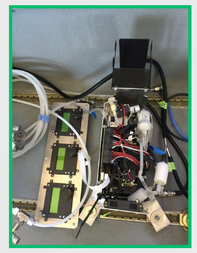
Existing and planned ArcticShark UAS Instrumentation

Instruments	Measurement
SPN-1, MFR, IR20	Radiation (broad band and spectral, SW and LW)
CDP	Cloud drop/ice crystal size distribution
ACCESS	Aerosol number, size distribution, absorption, filter sampler
POPS	Aerosol size distribution
AIMMS-30	Atmospheric state and thermodynamics, winds and turbulence
TBD	Passive remote sensing (imaging any wavelength)
TBD	Active remote sensing (radar, lidar)
Li-COR	Trace gases (CO2, H2O)



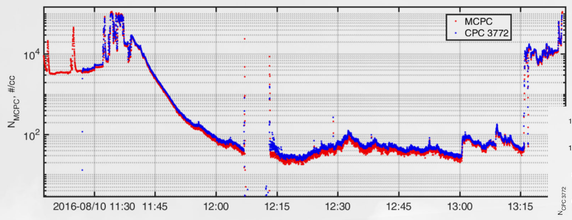


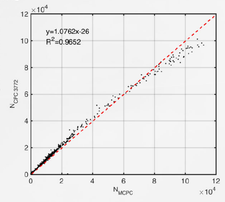
Comparing miniaturized with traditional size instruments aboard the Gulfstream-1



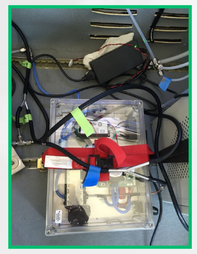
Brechtel MCPC 1710
Weight: 2.7 Kg

TSI CPC 3772
Weight: 6 Kg



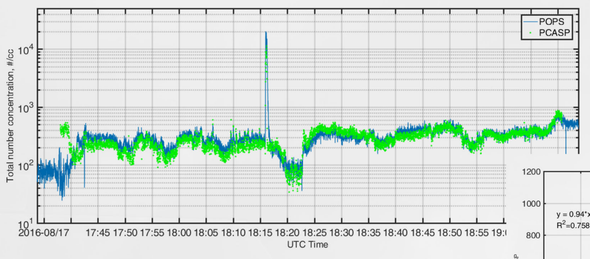


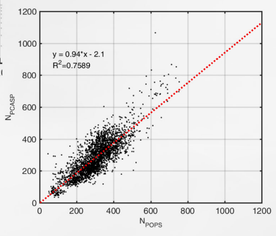
Aerosol Concentration, CPC vs. MCPC



Handix POPS
Weight: 0.8 Kg

PCASP
Weight: 20 Kg





Aerosol Concentration, PCASP vs. POPS (integrated over same size range)

For more information, contact:
Beat Schmid, PNNL
beat.schmid@pnnl.gov
(509) 375-2996

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