UAS for Meteorological and Atmospheric Science

Current and Future Uses of UAS for Improved Forecasts/Warnings and Other Scientific Studies Workshop, Oct 29, 2019

NOAA Unmanned Aircraft Systems Program

Captain Philip Hall, Director, NOAA UAS Program
Office of Oceanic and Atmospheric Research (OAR)

Overview

- NOAA UAS Program Overview
- Completed Projects
- Current Projects
- Future Projects
- Challenges for Transition to Operations

UAS Program Mission

- Facilitate UAS applications and utilization
- Accelerate the R2O transition
- Provide expertise and resources for UAS R&D

AeroVironment Puma

Aerial Imaging Solutions APH-22

NOAA Unmanned Aircraft Systems Program

Research to Operations

- Project Grants
- Directed Research Projects
- Strategic Partnerships

Black Swift S-2

Area-I ALTIUS

L3 Latitude FRV-55

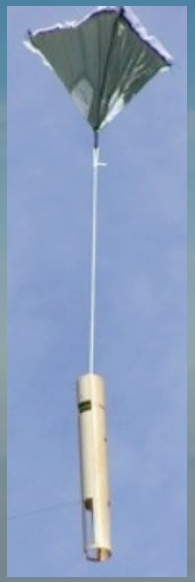
NOAA Unmanned Aircraft Systems Program

Research Contracts and Partnerships

UAS Meteorological and Atmospheric Science

Completed Projects

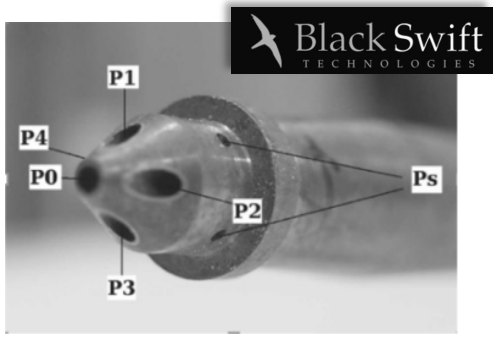
High Impact Weather Monitoring



Sensing Hazards with Operational Unmanned Systems Technology (SHOUT)

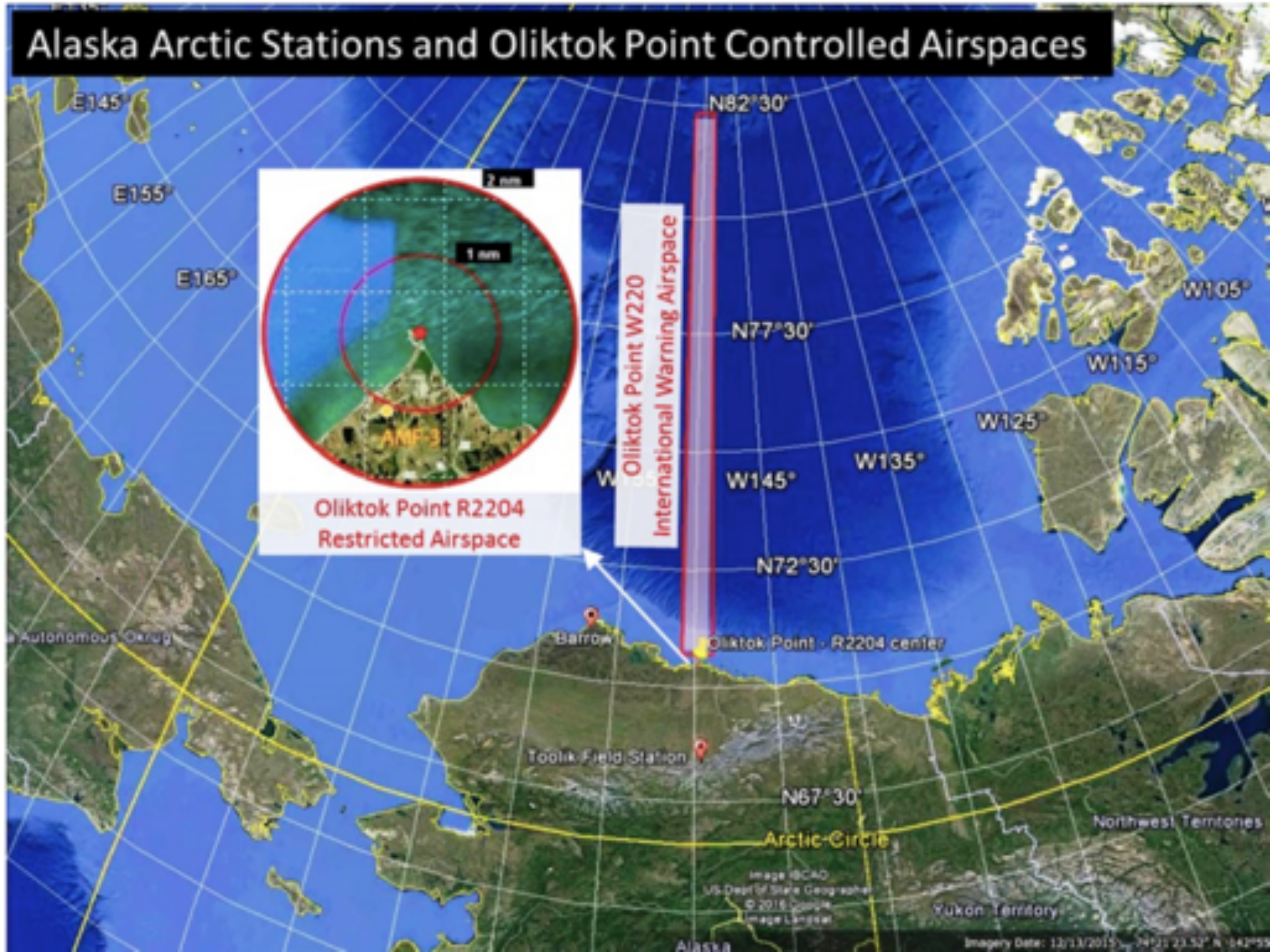
Flux Measurements from UAS

Univ. of Alaska Sea Hunter UAS with NOAA miniFlux Instrument



MiniFlux Probe

Alaska Arctic Stations and Oliktok Point Controlled Airspaces



UAS Meteorological and Atmospheric Science

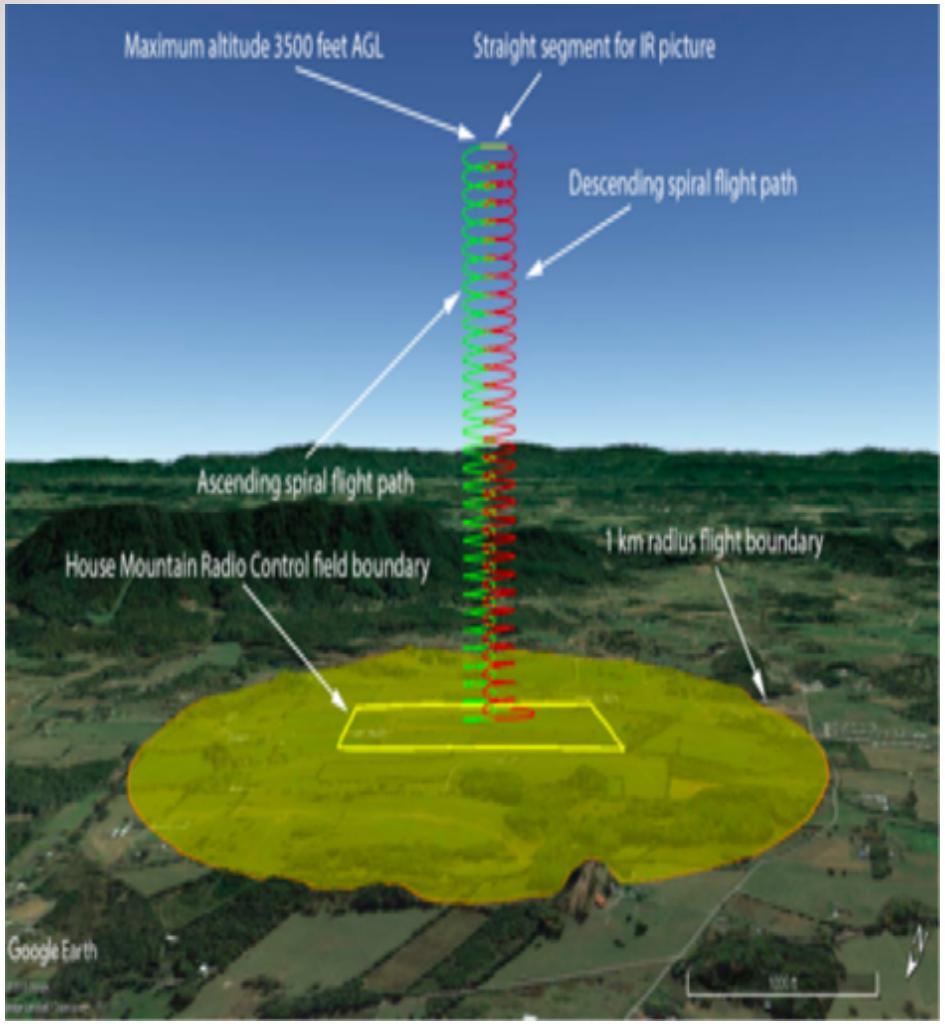
Current Projects

Vertical Profile Meteorology Operations

Platforms

BlackSwift Technologies S2

Meteomatics Meteodrone SSE



Sensing Hazards with Operational Unmanned Technology for NWS River Flood Forecasting (SHOUT4Rivers)

- Rapid response UAS
- Provide lower resolution imagery to NWS in real time for flood prediction and reporting.
- Process higher resolution imagery for model validation and verification later.

Griffon Outlaw G2E UAS from MSU's Raspet Flight Research Center

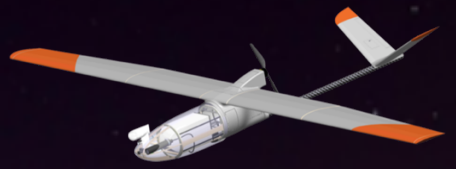
Collaborators: NOAA Northern Gulf Institute; National Weather Service, Lower Mississippi River Forecast Center (Louisiana); NOAA National Water Center (Alabama); Mississippi State University

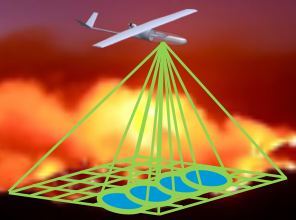
NightFOX: the Nighttime Fire Observations eXperiment

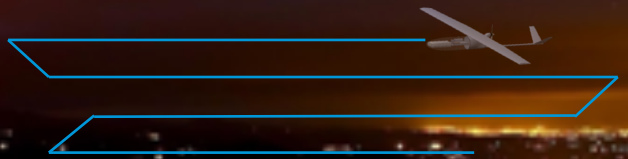
sUAS wildfire measurements in support of FIREX-AQ and fire weather forecasting

Goals:

1. Develop small UAS Observation Systems (sUASOS) for in situ and remote sensing wildfire measurements
2. Use the sUASOS for wildfire measurements to characterize nighttime fire emissions and fire extent and intensity in support of the NOAA/NASA FIREX-AQ field mission
3. Incorporate the fire observations to inform, test, and improve fire weather modelling







Dr. Ru-shan Gau, OAR CSD, Dr. Troy Thornberry, CIRES CSD

UAS Meteorological and Atmospheric Science

Future Projects

Testing Small UAS for Operations at NWS Alaska

Building an Operational Program for Small UAS for Flood Mitigation, Rapid Response, and Routine Equipment Inspection in NWS Alaska

Dr. Jessica Cherry, NWS Alaska-Pacific River Forecast Center

NWS Eastern Region Drone Team Pilot Project

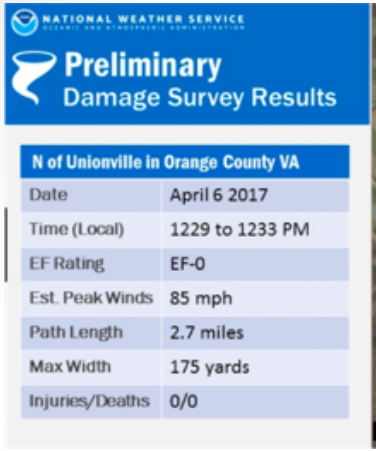
Platform: 3DR solo

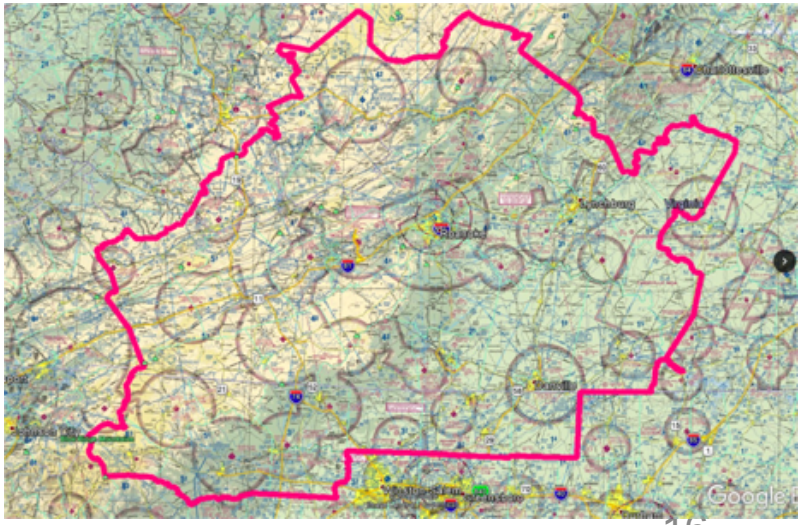
Pilots: NWS Forcasters

CONOPS:

Coordination between AOC and NWS

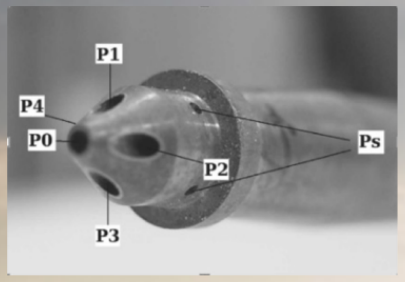
Schedule: Mission ready - Sept 2019



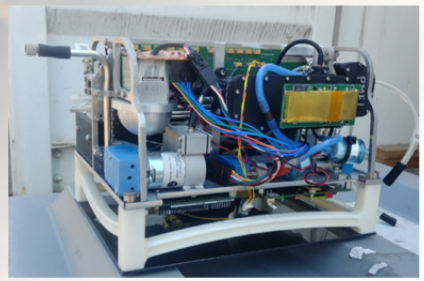


Project partners:
NWS WFO CHS & RNK and OMAO/AOC and UASPO)

Atlantic Tradewind Ocean-Atmosphere Mesoscale Interaction Campaign (ATOMIC)



MiniFlux Payload



Clear & Cloudy Sky Payload

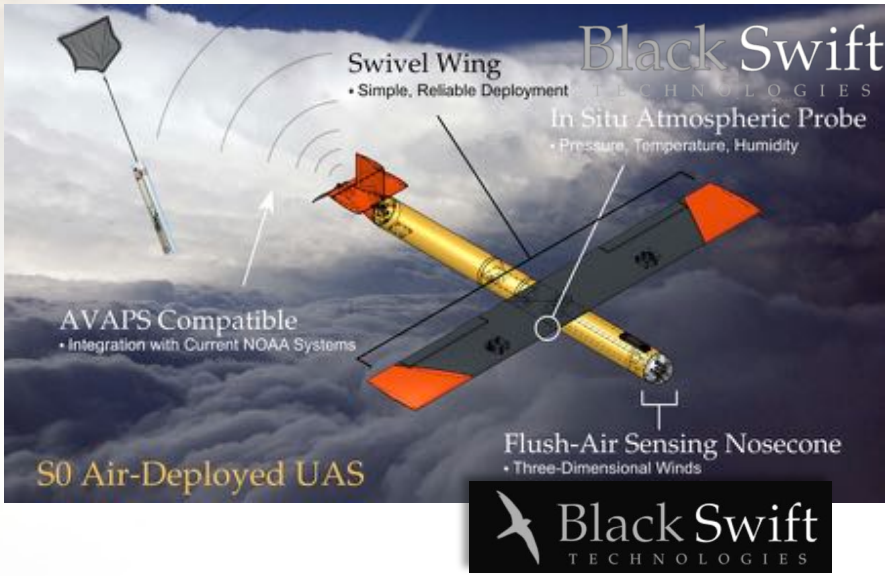
L-3 Latitude FRV-55 Hybrid VTOL

- Jan-Feb 2020
- Barbados and Caribbean
- BVLOS Operations

NOAA Ship Ronald H. Brown

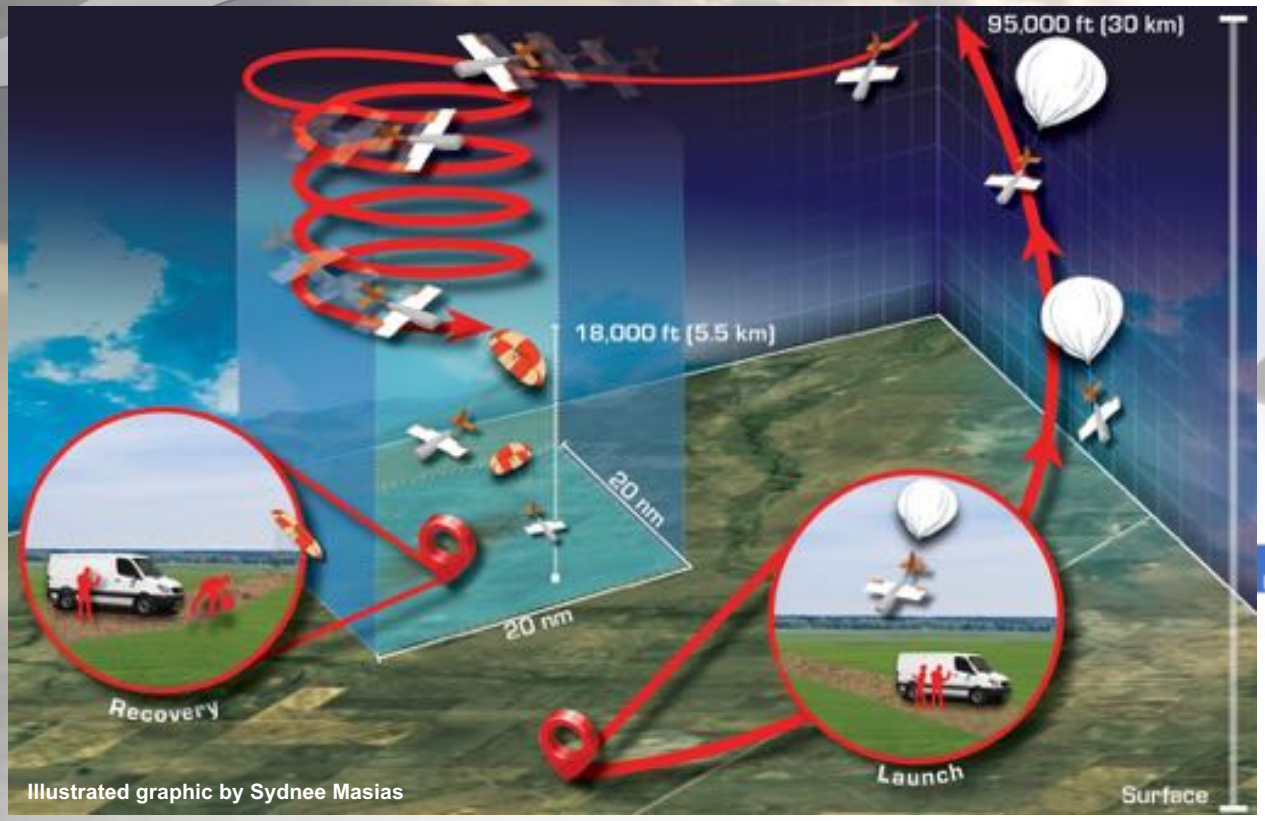
Dr. Trish Quinn (PMEL), Dr. Tim Bates (Univ. Washington)
Dr. Janet Intrieri (ESRL PSD), Dr. Gijs de Boer (ESRL PSD CIRES)

Expendable UAS Observations in Tropical Cyclones

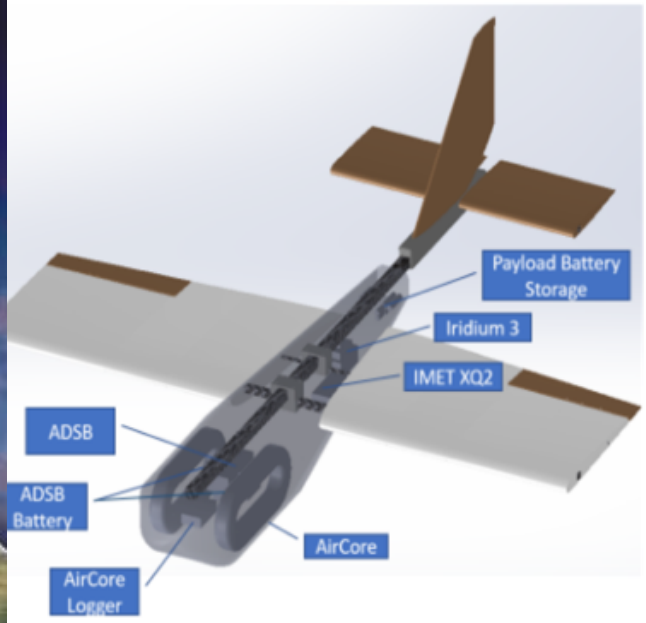


- Measure areas of the storm hazardous to P-3 Orion
- Low altitude meteorological data
- Targetable, continuous observations
- Provides critical dataset for hurricane research

High-altitude Operational Return Unmanned System



HORUS sUAS balloon-based ascent, autopilot descent, parachute recovery

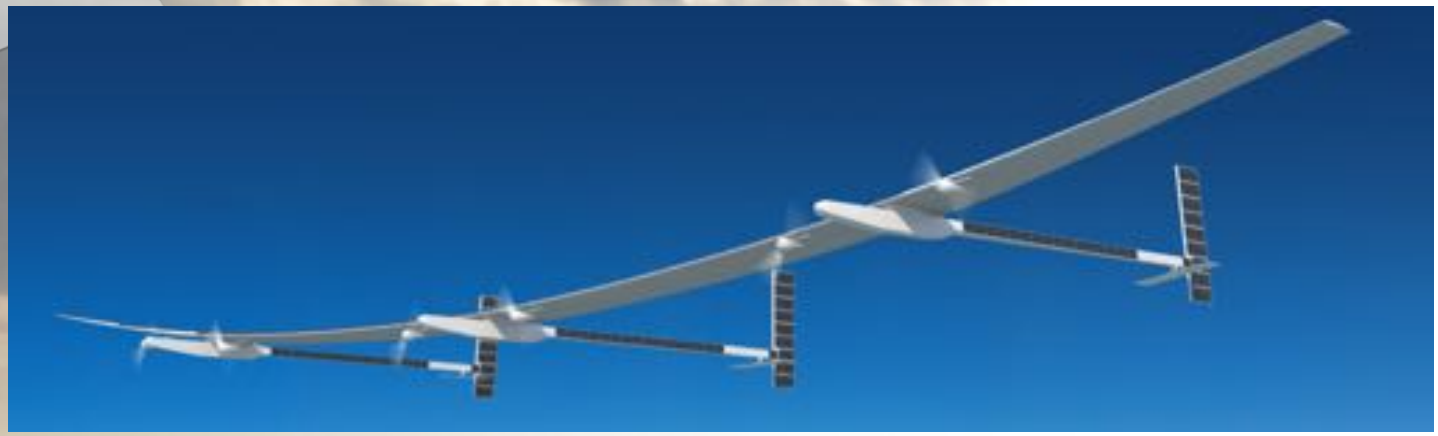


Payload capacity: 12 lb

- Lightweight AirCore samplers and associated sensors allow for higher-quality meteorological payload than typical weather balloon

Colm Sweeney, OAR GMD, with CIRES GMD and Arizona State University Co-Is

ODEx: Odysseus Demonstration Experiment



- Short term: Demonstration of the scientific capabilities
  - Two key instruments for ozone and aerosol
- Longer term:
  - Storm/severe weather tracking
  - Remote sensing instruments and dropsondes.
  - Asian Summer Monsoon Anticyclone measurements

- Longer term:
  - Trace gases and aerosol instruments
  - Profiling the Tropical Tropopause Layer around the globe for detailed cirrus cloud and dehydration studies.
  - Water vapor and aerosol instruments, fiber optics or microwave temperature profiler
  - Cloud and radiation studies
  - Hemispheric camera and radiometers

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

CIRES

Aurora FLIGHT SCIENCES A BOEING COMPANY

Challenges to the Transition of UAS for Meteorological Operations

- NOAA has FAA wide area approval to fly to 1,200ft AGL. Altitude limit is too low for critical atmospheric measurements
  - minimum needed is 9,800 ft (3.0 km)
- Detect and avoid requirement prevents flying in clouds, requires night time lighting, and limits UAS altitude.
  - NOAA has approved waiver for 3,300 ft (1.0 km)
- There are no established standards for alternative mitigations to detect and avoid requirements
  - It is up to the program to propose safety mitigations
  - ADSB is not a mitigation due to non-participating aircraft
  - Proposed track and ID requirement will not immediately be a solution
- It is challenging to train NOAA personnel to be proficient as UAS pilots as well as normal duties

Possible Solutions and Mitigations

- Mitigation of detect and avoid requirements
  - Ground based radar
  - ATC Data Feed
  - Aircraft Awareness and Detection
- Hazard Risk Analysis
  - Low density airspace
  - Oceanic airspace
  - Non-navigable airspace

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