Small Unmanned Aircraft Systems Research and Operations in Tropical Cyclones (sUAS-ROTC)

Duration: Since 2014 (5+ years)

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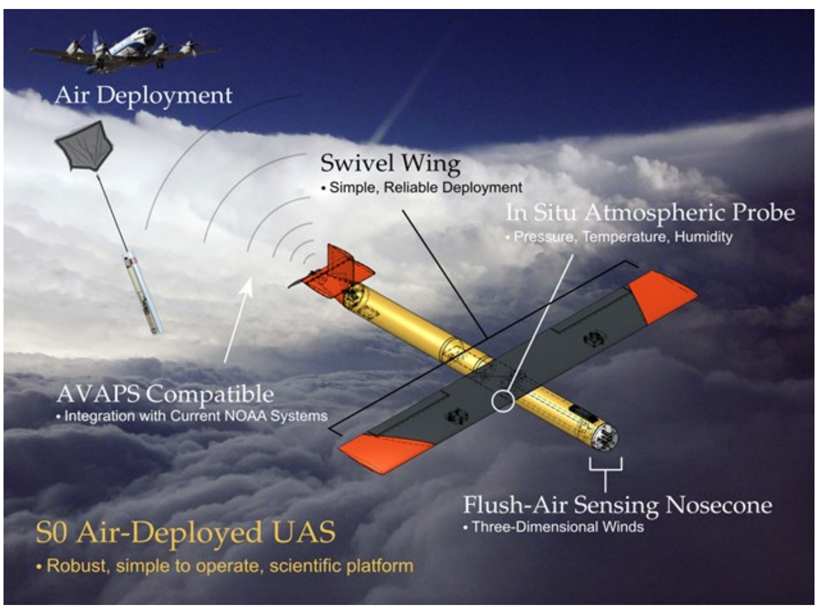
Area-I ALTIUS 600 UAS Air Launched UAS and NOAA WP-3D in Hurricane (Conceptual Image).

Primary Project Goals
Develop and refine measurement technologies that provide improved real-time monitoring of tropical cyclone intensity, structure, and environment. Enhance basic understanding to improve the physical representativeness of operational numerical models used to predict tropical cyclone intensity change.

Why small Unmanned Aircraft Systems (sUAS)

In recent years, an increasing number of hurricanes have impacted the United States with devastating results, and many experts expect this trend to continue in the years ahead. In the wake of powerful recent Hurricanes Sandy (2012), Harvey (2017), Irma (2017) Maria (2017) and Michael (2018), NOAA is working to provide improved and highly accurate hurricane-related forecasts over a longer time window prior to landfall. NOAA therefore has taken on the challenge to develop a program that will require applying the best science and technology available to improve hurricane prediction without placing NOAA personnel at increased risk. Unmanned Aircraft Systems (UAS) are an emerging technology in the civil and research arena capable of responding to this need.

NOAA is testing and developing three small UAS platforms with the ultimate goal of flying them into the boundary layer environment — i.e. where the hurricane meets the surface of the ocean — of mature hurricanes. The first effort is the OAR-funded project with AREA-I Inc., while the other two of these efforts (with Black Swift Industries and Barron Associates) are being funded through NOAA's Small Business Innovation Research (SBIR) Program.



BlackSwift S0 Air-Deployable sUAS.

Barron Associates Wingsonde Air-Deployable sUAS.

This effort is important because, though the interaction between the ocean and hurricanes is important and complex, current ocean observing methods are limited in their ability to fully understand this relationship. Hurricanes depend on the ocean to supply the necessary heat and moisture to form and maintain the system. The detailed process by which a storm draws heat from the ocean and ultimately converts it into kinetic energy (i.e. strong winds) is very complex and is currently not well understood. This lack of understanding is primarily due to the limited availability of detailed observations within the storm in the boundary layer. The amount of heat and moisture extracted from the ocean is a function of wind speed, ocean temperature, atmospheric temperature, pressure and humidity. Accurate measurements of these variables are needed, yet exceedingly difficult to obtain due to the severe weather conditions that exist at the ocean surface during a hurricane. A limited array of surface buoys make in-situ measurements in the boundary layer spotty, while direct measurements at very low altitudes using NOAA and Air Force hurricane hunter manned aircraft is impossible due to the severe safety risks involved. Nevertheless, for scientists to dramatically improve our understanding of this rarely observed region, detailed, continuous observations must be obtained.

Impacts of this effort

To this end, the utilization of sUAS designed to penetrate and sample the violent low level hurricane environment would help fill this critical data void. This effort will help assess:

- The strength and location of the storm's strongest winds
- The radius of maximum winds
- The storm's minimum sea level pressure (potentially give forecasters advanced warning as it relates to dangerous episodes of tropical cyclone rapid intensification)
- Thermodynamic conditions (particular low level moisture) within the lower troposphere

In addition, developing the capability to routinely fly sUAS into tropical cyclones will also help advance NOAA research by allowing scientists to sample and analyze a region of the storm that would otherwise be impossible to observe in great detail (due to the severe safety risks involved associated with manned reconnaissance). Such improvements in basic understanding are likely to improve future numerical forecasts of tropical cyclone intensity change. Reducing the uncertainty associated with tropical cyclone intensity forecasts remains a top priority of the National Hurricane Center. Over time, sUAS efforts that explore the utilization of unconventional and innovative technologies in order to more effectively sample critical regions of the storm environment should help reduce this inherent uncertainty. Enhancing this predictive capability would in turn reduce the devastating impact hurricanes have on our Nation’s economy and more importantly help save countless lives.