## UAV Applications and Sensor Development

# **Desert Research Institute**

#### Overview

Scientists and engineers at the Desert Research Institute have utilized manned and unmanned aerial acquisitions since the early 1970's to meet research goals associated with atmospheric and ecological assessment and monitoring. Many of the Institute's early unmanned efforts employed various balloon platforms to measure a number of atmospheric properties along a vertical profile.

Recognizing the importance of assessing horizontal spatial heterogeneity and acquiring timely synoptic coverage of ecosystem processes, DRI faculty and students have been actively developing modern UAV platforms with several partner institutions. Examples of these efforts include the design, fabrication and deployment of sensors and sensor packages, real-time and post data collection analytics and data visualization utilizing DRI's state-of-the-art, six-sided Virtual Reality Enclosure.



DRI performs research on every continent and has worked with nearly all of the Southwestern U.S. military bases with funding sources including the NOAA, DOE,

DoD, NSF and NASA. DRI currently has contracts for monitoring projects on a number of U.S. military bases and a grant to assess climate change adaptation at NASA's Dryden Flight Research Center.

#### Sensor and UAV Innovation at DRI

Several DRI researchers are pursuing atmospheric sensor miniaturization to adapt sensors and sensor packages originally deployed on manned aircraft for UAV platforms and look forward to the potential to collaborate with industry on these efforts. DRI faculty currently hold four sensor patents and have commercialized three versions of a photoacoustic instrument for Droplet Measurement Technology. Other researchers are actively pursuing enhancement of DRI's UAV hardware through future purchases of both fixed wing and helicopter UAV platforms and several commercially available sensors such as a hyperspectral imaging sensor.





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### UAV Related Research Themes

- Development of instruments and instrument packages for environmental applications: Instrument science
- T-Probe to measure cloud liquid water and ice content was fabricated and deployed on a NSF/NCAR manned aircraft
- Onboard emission sensor packages to measure particulates and trace gasses in the atmosphere
- Contract with Pacific Northwest National Lab to fly a UAV-based instrument into forest and shrub smoke from wild land and agricultural burning
- Characterization of atmospheric aerosol and trace gases emitted due to transportation, agriculture, land use practices, biomass burning, dust storms
- Real time measurements of aerosol light scattering and absorption
- Organic chemistry speciation of trace gases and aerosol particles, e.g., trace gas concentration measurement, like NO<sub>2</sub>
- Improved landscape assessment to support missions of land management agencies like BLM and NRCS
- Added remote sensing capability with our ground based sun photometers and use of satellite remote sensing data from NASA operated instruments
- Ongoing measurement of air quality in many of the world's cities and National Parks
- Cloud microphysics measurements and models
- Development of cloud scopes for directly observing small ice crystals in cirrus clouds
- Characterization of clouds for use in climate and weather modeling and development of remote sensing algorithms

#### **DRI UAV Future Interests**

- Acquire new platforms Fixed wing and helicopter
- Design and develop smaller sensors
- Develop new sensor packages
- —Miniaturized cloud radar and cloud condensation nuclei counters
- Increase number and type of applications

   Real time characterization of wildfires for situational awareness, extreme weather events and other natural or man-made events that require instantaneous aerial observations from single or combined sensor packages

   Development of UAV cloud seeding with miniaturized
  - cloud seeding generators (Agl, propane, CO<sub>2</sub>)

–Water resource monitoring and high resolution data for hydrologic modeling

-Ecosystem response and monitoring, vegetation dynamics, forest stand analysis, utility line surveys, surface heat response

-Wildlife and domestic animal population studies

- Data analytics and visualization
- Student internships and training
- Industry partnership to expand UAV capacity within Nevada and commercialize sensors

