



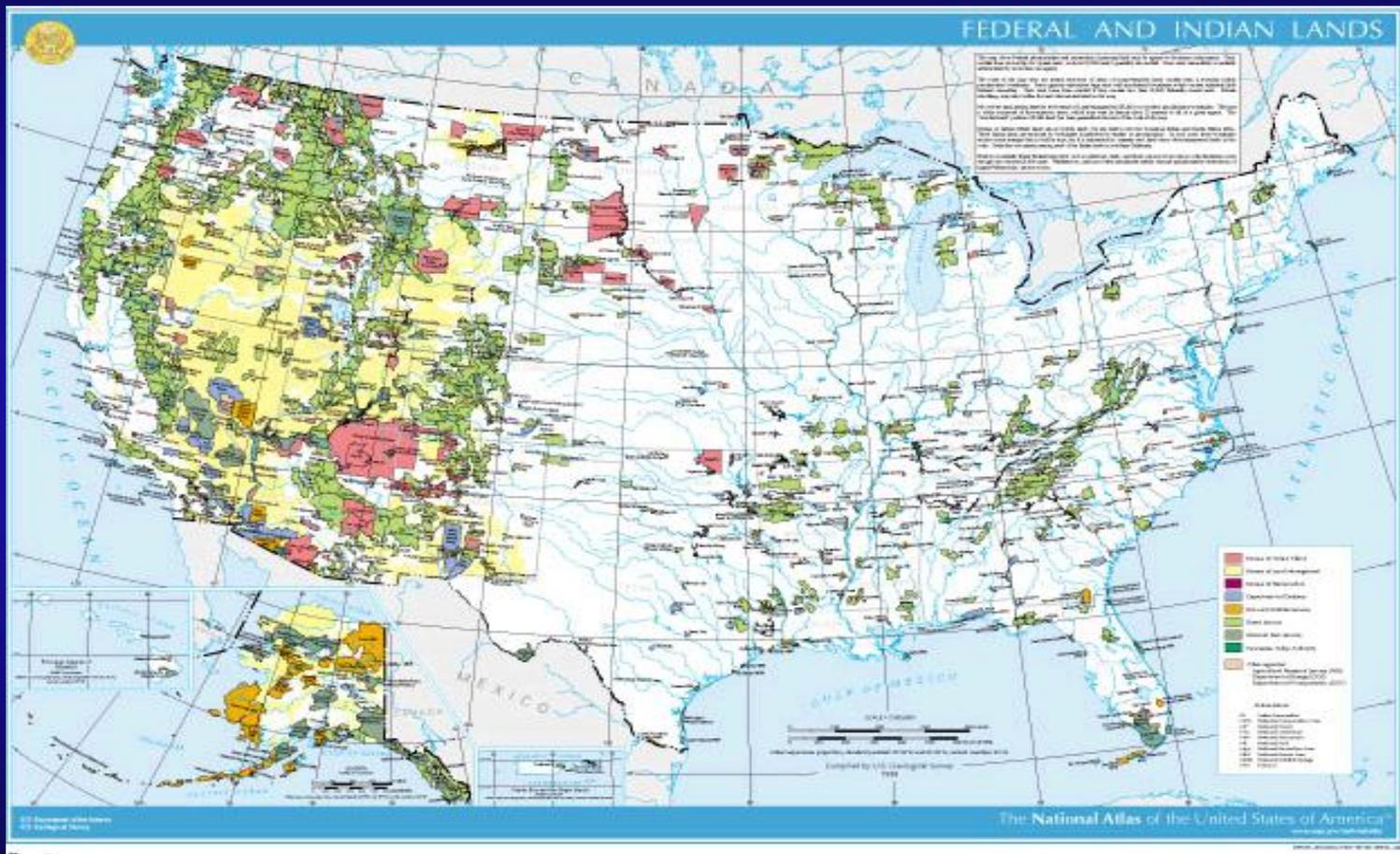
# U.S. GEOLOGICAL SURVEY UNMANNED AIRCRAFT SYSTEMS PROJECT OFFICE LESSONS LEARNED AND OPPORTUNITIES

U.S. Department of the Interior  
U.S. Geological Survey

Michael E. Hutt  
(303) 202-4296  
[mehutt@usgs.gov](mailto:mehutt@usgs.gov)



# U.S. Department of the Interior



# U.S. Geological Survey Mission:

- Serves the Nation as an independent fact-finding agency that collects, monitors, analyzes, and provides scientific understanding about natural resource conditions, issues, and problems
- Multi-disciplinary science organization with expertise in biology, geography, geology, geospatial information, and water
- Dedicated to the timely, relevant, and impartial study of the landscape, our natural resources, and natural hazards.



# USGS Land Remote Sensing Program- Unmanned Aircraft Systems (UAS) Emerging Technology Investigation



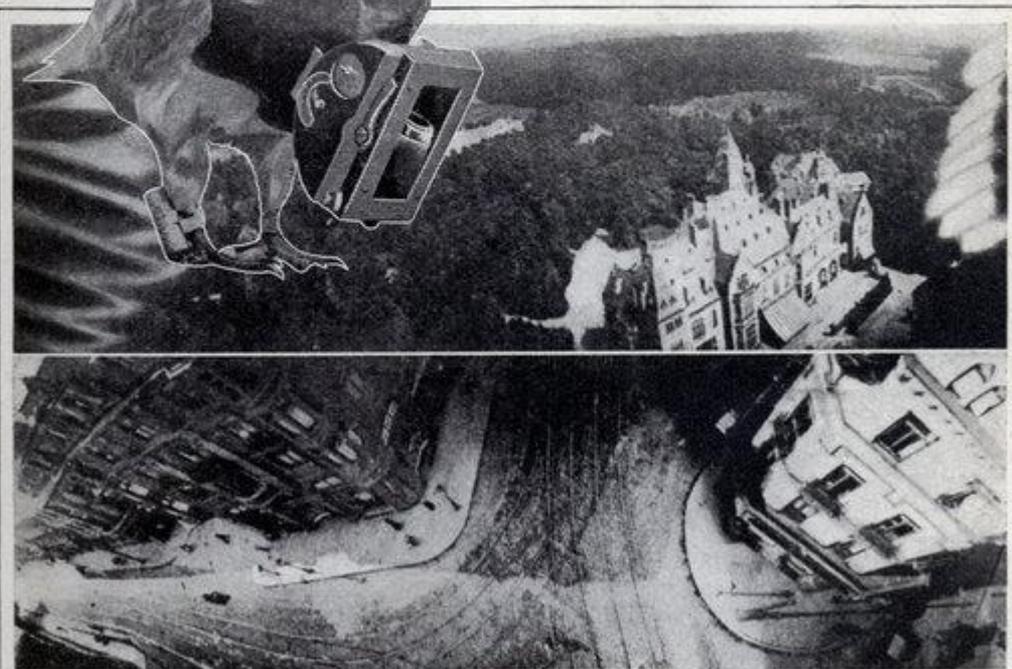
## Carrier Pigeons Take Aerial Photos With New Camera



**I**T IS no longer necessary to send planes over enemy lines to get photos of troop operations—carrier pigeons have now been pressed into service for this hazardous task.

This unusual feat is made possible by the development in Germany of a new diminutive aerial camera which is strapped to the pigeon's breast, as illustrated in the accompanying photo. Two hundred views may be taken while in flight, the shots being made possible only after the bird has left the ground. Each bird also carries a message tube strapped to its leg.

The German government has opened a school to train carrier pigeons for service in aerial photography.



Above are two remarkable panoramic views taken by pigeon carrying aerial camera. Insert shows how camera is carried.



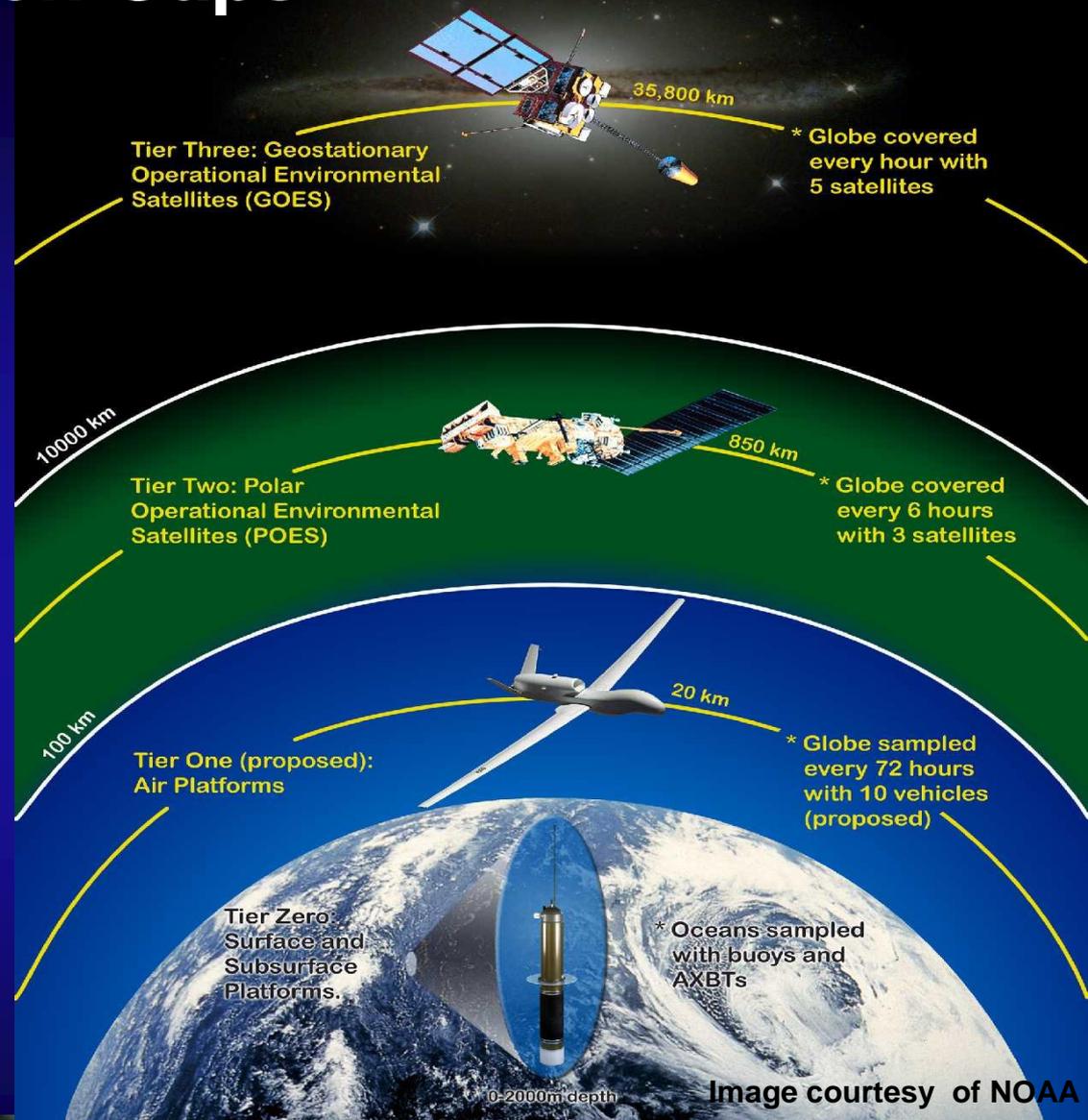
# Concern- Observation Gaps

Critical to gaining a better understanding of the complexities related of climate change research, water resources forecasting, ecosystem monitoring, land management and natural hazards

Gaps frequently exist over the remote, scarcely populated and often volatile lands managed by the Department of the Interior

Manned aircraft flights are problematic due to long flight durations, unpredictable weather and associated operations cost.

Satellite based observations are hindered by static sensor capabilities, weather conditions and acquisition cycles that are often measured in days or weeks.



# Emerging Technology Investigation Findings



# Assessment of UAS Technology:

- Military use of UAS technology was increasing exponentially,
- 5 year projections for UAS related investments were substantial,
- The Department of Defense, NOAA, NASA, DHS, and the FAA had or were in the process of establishing UAS Program Offices,
- No focal point existed in DOI or USGS to “champion” UAS,
- 60 Universities in the U.S. were offering UAS related programs,
- There were over 150 vendors of UAS technology,
- A wide variety of platforms (aircraft) and sensor packages,
- Growing interest by industry, academia and government to develop civil applications of UAS technology,
- Operational in hostile environments - smoke, ash, active volcano, bad weather, etc.,
- Technology would supplement , NOT REPLACE , manned aircraft and satellite observations



# Potential Benefits to USGS:

- **Increases safety of DOI aircraft crews & field staff- remove them from harms way,**
- **Provides large area and repeat coverage- compared to ground observations,**
- **Potential to dwell over areas of interest- support to day/ night operations,**
- **Readily available technology – near COTS solution,**
- **Relatively low costs to operate (sUAS)- compared to manned aircraft,**
- **Provides archive of images for future use and analysis,**
- **Puts technology in the hands of the scientists,**
- **New observations = new science = more informed decisions**



# Challenges Remain:

## Safety Issues

- Ensure the safety of the National Air Space
- Frequency (communications)
- Certificate of Authorization (COA) process
- Operator- Pilot Certification

## Scientific Investigations/ Incident Response

- Integration with other capabilities
- Authoritative analysis
- Archive responsibilities

## Understanding full cost of UAS missions

- Aligned with manned missions
- Value- demonstrate greater scientific value than manned operations

## Outreach- Training

- Management Awareness
- "ist" Awareness



# The Way Forward



# Establishment of USGS UAS Project Office- Boldly Going Where No Man (or Woman) Goes: USGS Unmanned Aircraft- USGS Press Release May 8, 2008

In dangerous and remote areas, such as polar regions, volcanic islands, and expansive deserts, remote-controlled unmanned aircraft can provide more detailed, more timely data about the status of natural resources and environmental conditions than would be feasible by any other means. That is why the U.S. Geological Survey - long known as an authoritative source of aerial photography and satellite-based imagery - today announced that it is establishing a new program for earth observation using Unmanned Aircraft Systems (UAS).

“This exciting approach to earth observation gives scientists a way to look longer, closer, and more frequently at some of the most remote areas of the Earth, places that were previously too dangerous or too expensive to monitor in detail,” said Barbara J. Ryan, USGS Associate Director for Geography. “The flexibility and relative low cost of unmanned aircraft systems will enhance our ability to track long-term landscape change. In addition, we can quickly assess landscape altering events, such as wildfires or volcanoes, in areas with challenging logistics.”

In many cases, UAS technology is simply the most cost effective way to gather earth observation data for a wide variety of applications: managing federal lands; investigating climate change; mapping and charting; conducting environmental risk assessments; responding to and recovering from natural and human-induced disasters.

Even in less remote areas, manned aircraft flights may not be feasible at times due to long flight durations, hazardous weather conditions, and associated operations cost. Satellite-based observations can be hindered by coarse image resolution, limited sensor capabilities, and repeat orbiting cycles of days or weeks. The use of UAS technology allows flexibility in delivering timely data. Furthermore, data collection by UAS can be specifically tailored to the required resolution and radiometric parameters of individual investigations.

An important focus of the USGS UAS Program, a component of the USGS Land Remote Sensing Program, is to leverage the commitment that the defense and intelligence communities have made in supporting UAS research. Working in partnership with many other Federal agencies, academia, and industry groups, the USGS will promote UAS technology for civil, domestic applications. Offices for the new program will be located at the USGS facility in Lakewood, Colo.



# USGS UAS Project Office Mission

Promote the development of cost effective, safe UAS technology in support of the U.S. Geological Survey and Department of the Interior Missions including: managing federal lands; monitoring environmental conditions and natural resources use; analyzing dynamic earth processes in support of global and climate change investigations; generating mapping, charting, and geodesy products; conducting environmental risk assessments; and preventing, preparing for, responding to, and recovering from natural and human-induced disasters.



# Strategic Opportunities- Missions

- Augmentation of Satellite and Aircraft observations
- Verification and validation of remotely sensed observations
- Maintain Strategic Awareness in support of Incident Command Operations
- Wildland Fire Tactical Support
- DOI Law Enforcement (crowd control, counter drug operations)
- Monitoring DOI assets (archeological sites, areas of critical habitat, critical infrastructure)
- Mapping (Digital Elevation Models, Image Collection)
- Land Management (monitoring rangeland and forest health conditions)
- Climate Change (monitoring carbon exchange)
- Logistical Support (seismic/ GPS sensors, material resupply)
- Communications (enhanced radio communications)
- Search and Rescue Operations
- Environmental Research
- Wildlife Inventories
- Air quality measurements (volcanic gas and ash emissions, wildfire smoke plume gasses)



# Key Partnerships/ Collaboration:

- International Society of Photogrammetry and Remote Sensing (ISPRS) Commission 1, UAS Working Group
- International Society of Remote Sensing for the Environment (ISRSE)
- The Association for Unmanned Vehicle Systems International (AUVSI)
- National Science Foundation (NSF), Federal Aviation Administration (FAA), Department of Homeland Security, (DHS), and AUVSI UAS working group
- American Association of Aeronautics and Astronautics (AIAA)
- USNORTHCOM UAS Working Group
- Interagency Coordinating Committee for Airborne Geoscience Research and Applications (ICCAGRA) UAS working group
- NOAA, NASA, FAA, DoD, Army UAS Program Offices
- National Guard Bureau (U.S. Army UAS War fighters Round Table)
- Department of the Interior Remote Sensing Working Group (DOIRWG)
- DOI Aviation Management Directorate
- Tactical Fire Remote Sensing Advisory Committee (TFRSAC)
- New Mexico State University, University of Colorado, Air Force Academy, University of Idaho, Utah State University, University of Alaska- Fairbanks, Massachusetts Institute of Technology, University of Florida , Virginia Tech.
- All USGS Disciplines



# Department of the Interior Aviation Management Directorate

- Aviation Safety Programs
- Aircraft Management Services
- Procurement of Aircraft
- Service Contracts
- Coordination of Assets



## Operational Procedures Memorandum 09-11

- Operator Certification
- Operator Currency Requirements
- Aircraft Safety Inspection Criteria
- Certificate of Authorization Process



# Raven System Utilization

**Provides an enterprise level, low cost, low risk capability to “cut our teeth”**

- operator training and certification
- Establish air worthiness inspection criteria
- Develop user applications and standard operation procedures
- GAP Analysis- sensors, platforms



Description	
Wing Span	4.5 ft
Air Vehicle Weight	4 lbs
Range	10+ km (LOS)
Airspeed	27-60 mph
Altitude	>300 AGL
Endurance	90 min Lithium
Payload	- Improved Day Camera – wider field of view, increased resolution, 3X Zoom, Ethernet, National Television Standard Compliant (NTSC)
	- External Interfaces
Payload	- IR with Laser Illuminator –25 ft spot marking capability
	- External Interfaces
GCS/RVT	- Combined Weight – 14 lbs

## Characteristics

- Rapidly deployed
- Decentralized planning and execution
- Cost effective
- Easily transportable

## Raven Operational Mission Sets

- Remote reconnaissance and surveillance
- Damage assessment
- Resource inventory Support

## Benefits/Capabilities

Provides enhanced situational awareness by providing expanded reconnaissance and surveillance coverage.

- Hand-launched
- GPS
- Semi-autonomous operations and in-flight retasking
- Commanded auto-loiter at sensor point of interest
- Executes lost link recovery procedures



# U.S. Geological Survey Roadmap

**USGS is working with our Department of the Interior partners, NASA, NOAA, academia and private industry to assess the capabilities of Unmanned Aircraft Systems for civil use. A key part of this activity is to develop a report that will serve as a roadmap for the development of these applications. The intent of that report is to:**

- **To determine and document potential future civil missions for UAS technology based on user-defined requirements.**
- **To determine and document the technologies necessary to support those requirements.**
- **To discuss the present state of the UAS capabilities**
- **Identify those technologies in development and those for which no current plans exist**
- **Serve as the foundation for USGS UAS related budget proposals**
- **Provide the foundations for development of a comprehensive civil UAS roadmap.**



# Summary

UAS technology has the potential to effectively fill current observation gaps that are critical to gaining a better understanding and scientific knowledge related to climate change research, water resources forecasting, ecosystem monitoring and management and natural hazards.

Unmanned Aircraft Systems (UAS) will transform the methods and techniques employed across the Department of the Interior (DOI) and the United States Geological Survey (USGS)

Web Site- <http://rmgsc.cr.usgs.gov/UAS/>

