

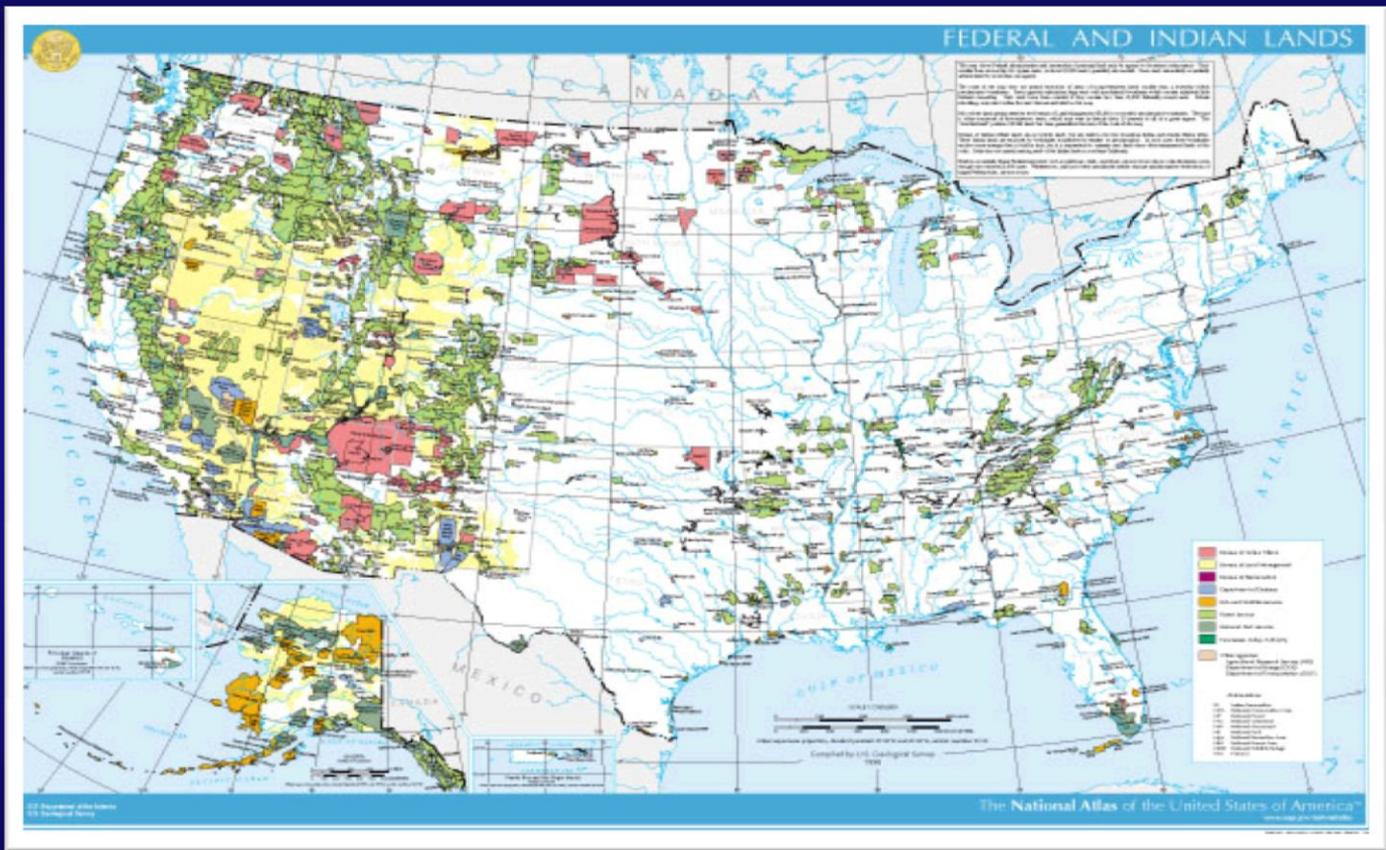
U.S. GEOLOGICAL SURVEY UNMANNED AIRCRAFT SYSTEMS PROJECT OFFICE

LESSON LEARNED AND OPPORTUNITIES

Michael E. Hutt



U.S. Department of the Interior

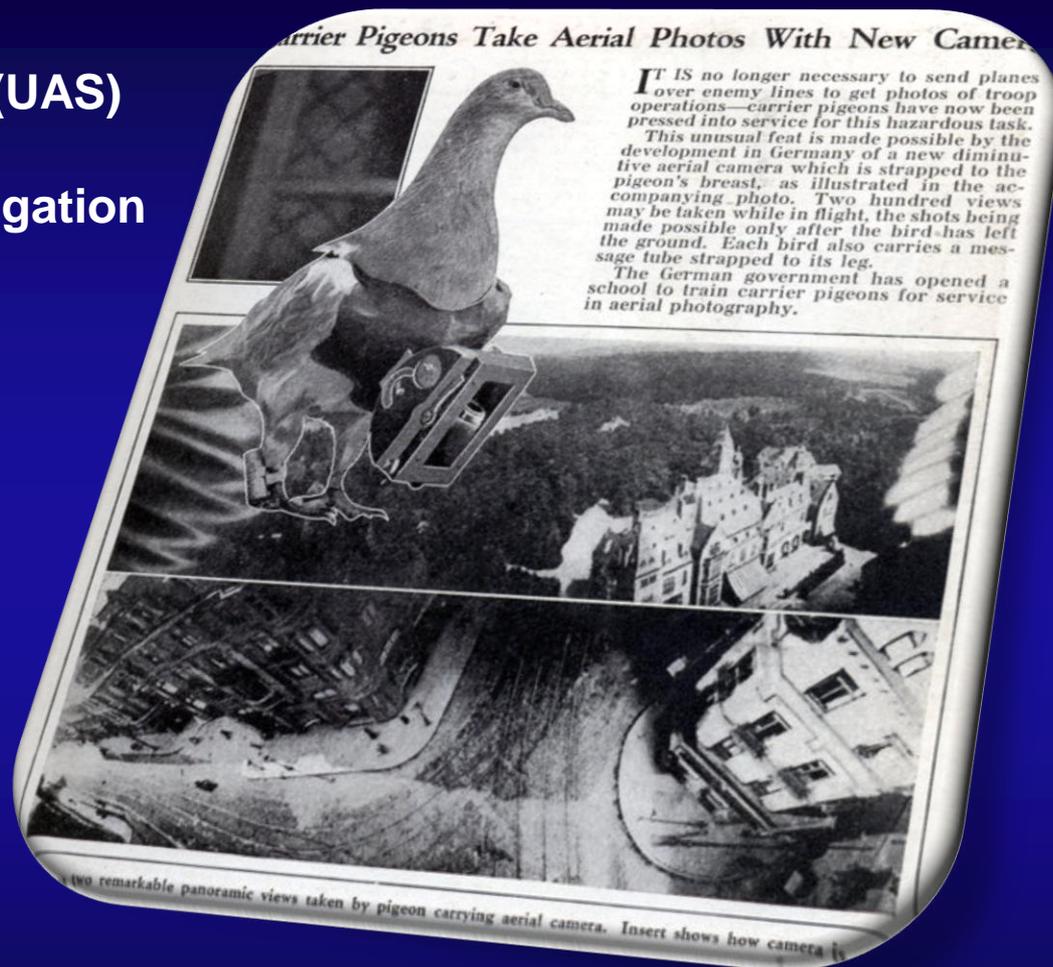


507 million acres of land or 1 out of every 5 acres in U.S. is Dept. of Interior's management responsibility.
In addition 190 million acres (USDA) - 29 million acres (DOD)



USGS - Land Remote Sensing Program- Unmanned Aircraft Systems (UAS)

Emerging Technology Investigation



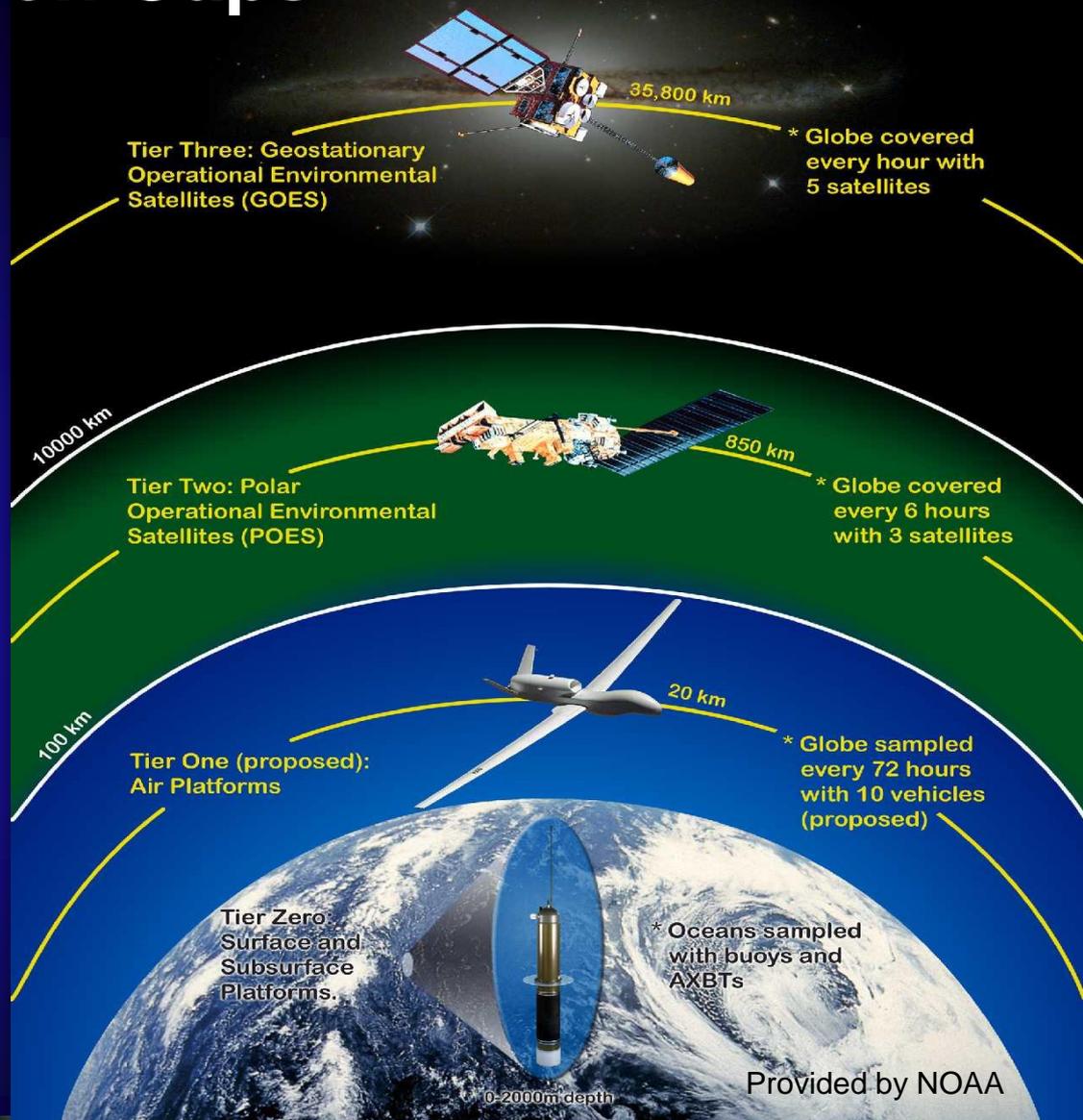
Problem - Observation Gaps

Image courtesy of NOAA

Gaps exist in acquiring remotely sensed data over the remote, scarcely populated and often volatile lands managed by the Department of the Interior

Manned aircraft flights can be problematic due to long flight durations, unpredictable weather, day & night data requirements and associated operating costs

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



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



Potential Benefits to USGS:

- **Increases safety of DOI aircraft crews & field staff**
- **Provides large area and repeat coverage**
- **Potential to dwell over areas of interest**
- **Support to both day & night operations**
- **Commercial solution – readily available**
- **Lower cost to operate sUAS compared to manned aircraft**
- **Provides for imagery capture, assures full coverage & real-time ground viewing**
- **Puts technology in the hands of the scientists**
- **Green Technology**
- **Long term archive of observations**
- **New observations = new science = more informed decisions**



USGS UAS Project Office Mission



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Land Remote Sensing Program Unmanned Aircraft Systems (UAS) Project Office

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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.



Where we started-



COA Lessons Learned

UAS COA Case	
ASN #:	2010-CSA-20-COA
Case Status:	RELEASED
Submitted:	04/21/2010
Proponent Information	
Point of Contact Information	
Operational Description	
System Description	
Performance Characteristics	
Airworthiness	
Procedures	
Avionics/Equipment	
Lights	
Spectrum Analysis Approval	
ATC Communications	
Electronic Surveillance/ Detection Capability	
Visual Surveillance/ Detection Capability	
Aircraft Performance Recording	
Flight Operations Area/Plan	
Flight Aircrew Qualifications	
Special Circumstances	
Preview Case	
COA Status History	
Status Notes History	

6 Approvals for flying a UAS in National Airspace

COA



1. **Airspace FAA**
2. **Range Control or Controlling Agency**
3. **Spectrum Approval (USGS-DOI-NTIA)**
4. **AMD (DOI)**
5. **USGS Aviation Safety**
6. **Scientists- Resource Manager**



Where we are today-

Provides USGS and our partners with an enterprise level , low cost, low risk UAS 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
	- IR with Laser Illuminator –25 ft spot marking capability
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



Additional Systems: Dragon Eye & WASP

Features Fully Autonomous Operation, In-Flight reprogramming, Small Size, Lightweight, Bungee-Launched, Waypoint Navigation, Laptop Mapping, Image Capture.

- Payloads Dual Forward- and Side-Look EO Camera Nose, Forward- and Side-Look Low Light Camera Nose and Side-Look IR Camera Nose.
- Range 5 km
- Speed 35 km/h
- Operating Altitude (Typ.) 100–500 ft AGL
- Span 3.75 ft (1.1 m)
- Length 3 ft (0.9 m)
- Weight 5.9 lb (2.7 kg)
- Launch Method Bungee-Launched
- Recovery Method Conventional Horizontal Landing
- Endurance 45–60 minutes (Single Use Battery)

Features - Miniature Size, Ruggedized for use on Land and Sea, Autonomous Flight, GPS, Altimeter, Autonomous Navigation

- Payloads - Integrated Forward- and Side- Look EO Cameras,
- Swappable Payloads
- High-Resolution EO Camera, IR Imager
- Electronic Pan/Tilt/Zoom
- GCS - Common Ground Control Station same as Raven
- Range 5 km
- Endurance - 45 minutes
- Speed - 40-65 km/h
- Operating Altitude (Typ.) - 50-1,000 ft AGL, 15-300 m AGL
- Wing Span - 2.375 ft (72 cm) Length - 1.25 ft (38 cm)
- Weight - 0.95 lb/430 g (Land)
- Launch Method - Hand-launched
- Recovery Method - Horizontal Land



Department of the Interior Aviation Management Directorate

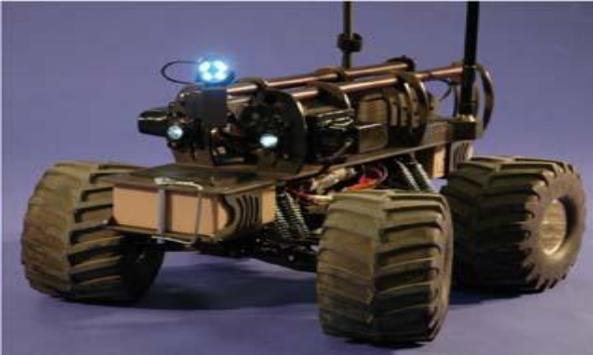
- Aviation Safety Programs
- Aircraft Management Services
- Procurement of Aircraft
- Service Contracts
- Coordination of Assets



- Operational Procedures Memorandum 09-11
- Operator Certification
- Operator Currency Requirements
- Aircraft Safety Inspection Criteria
- Certificate of Authorization Process



Possibilities – Where we can go...



Lighter than Air



Hyperblimp



Long Endurance Multi-Intelligence Vehicle (LEMV)



Sofcoast



U.S. Geological Survey Roadmap

USGS is with many federal partners to develop a report that will serve as a roadmap for the development of UAS applications.

The intent of that report is to:

- **Document potential future civil missions for UAS technology based on user-defined requirements**
- **Document the technologies necessary to support those requirements**
- **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**





Projects in Process:

Projects	Area	Location	COA
•Ft. Carson Train. (restricted)	Colorado Spgs, CO	Ft. Carson Army Base	Approved
•Training & Proficiency	Las Cruces, NM	Jornada Exper. Range	Released
•Sandhill Crane Pop. Estimate	Alamosa, CO	Monte Vista NWR	Re-Committed
•Delta NWR – Gulf Oil Spill	Gulf Coast	Delta NWR, LA	Rejected
•Everglades	Florida	Everglades NP	Planning
•Pine Beetle Tree Mortality	Colorado	Grand County	Draft
•Sediment Particle/River Beds	California	Lake Isabella, CA	Draft
•Dinosaur Trackway	Colorado	Purgatoire Valley	Proposed
•Moose Populations	TBD	TBD	Proposed
•Wildfire Support	TBD	TBD	Proposed
•Invasive (Feral) Cats	Hawaii	Kaho’olawi, HI	Proposed
•Glacial Temperatures	Washington	South Cascade Glacier	Proposed
•Pygmy Rabbit Landscapes	Idaho	TBD	Proposed



Fire – Dugway, UT

Electro-Optical Video of Prescribed Burn



Sandhill Cranes, Alamosa CO

USGS, FWS

- Population estimates and surveys 20,000 Cranes
- Monte Vista National Refuge



Everglades

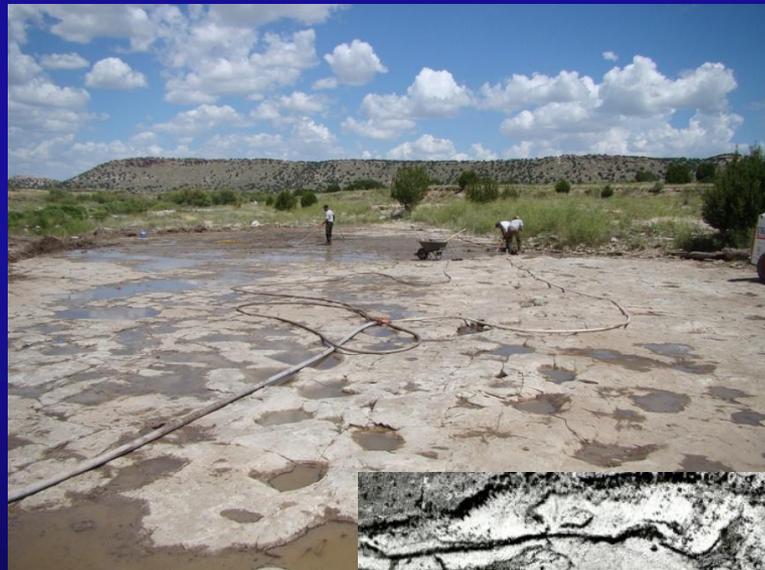
- Turtle nesting on remote beach of Cape Sable
- Counting manatees in coastal Everglades
- Sawfish population estimates in shallow waters
- Assess vegetation in estuarine area
- Monitor mangrove fringe
- Fire assessments in the park



Dinosaur Trackway

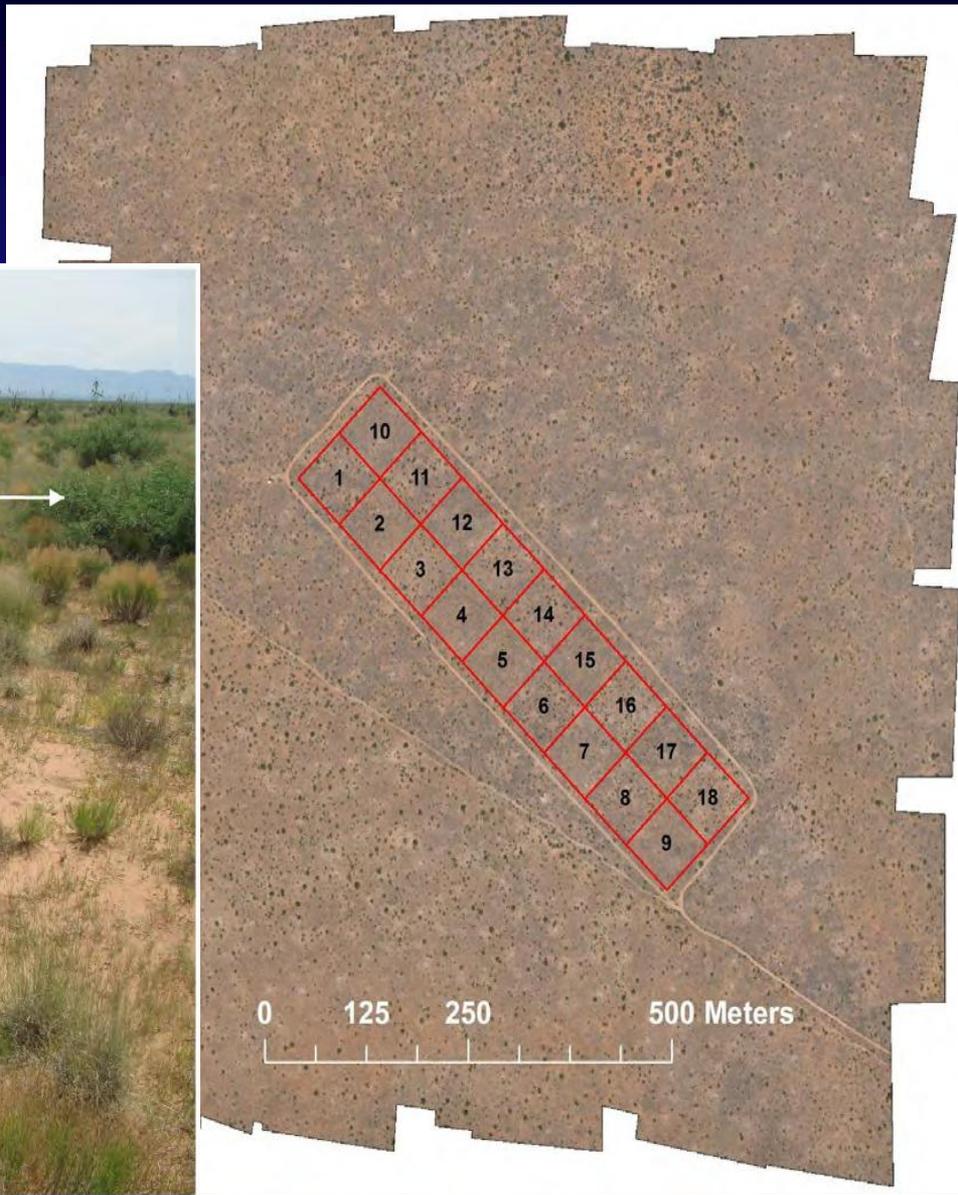
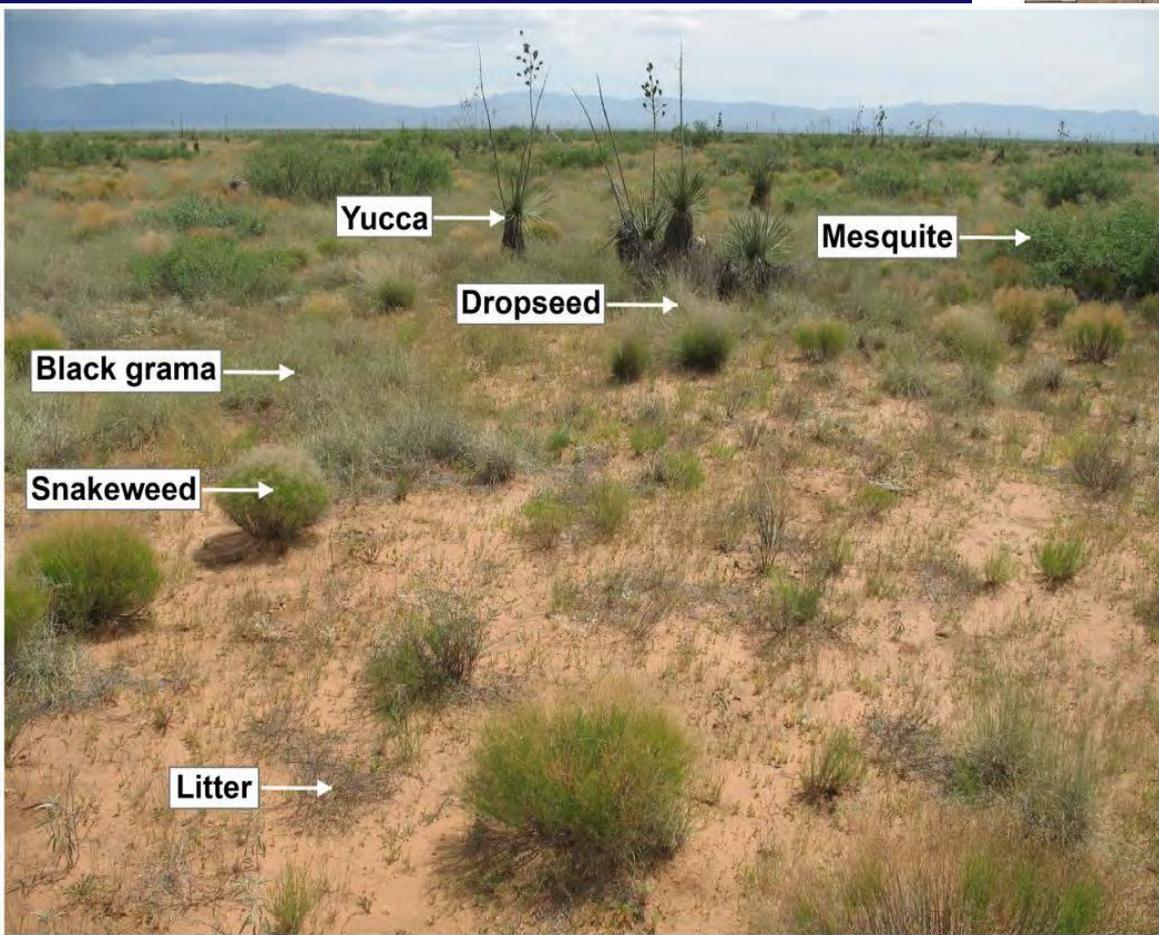
BLM, USGS

- Purgatoire River, CO
- Video collects of the Tracksite

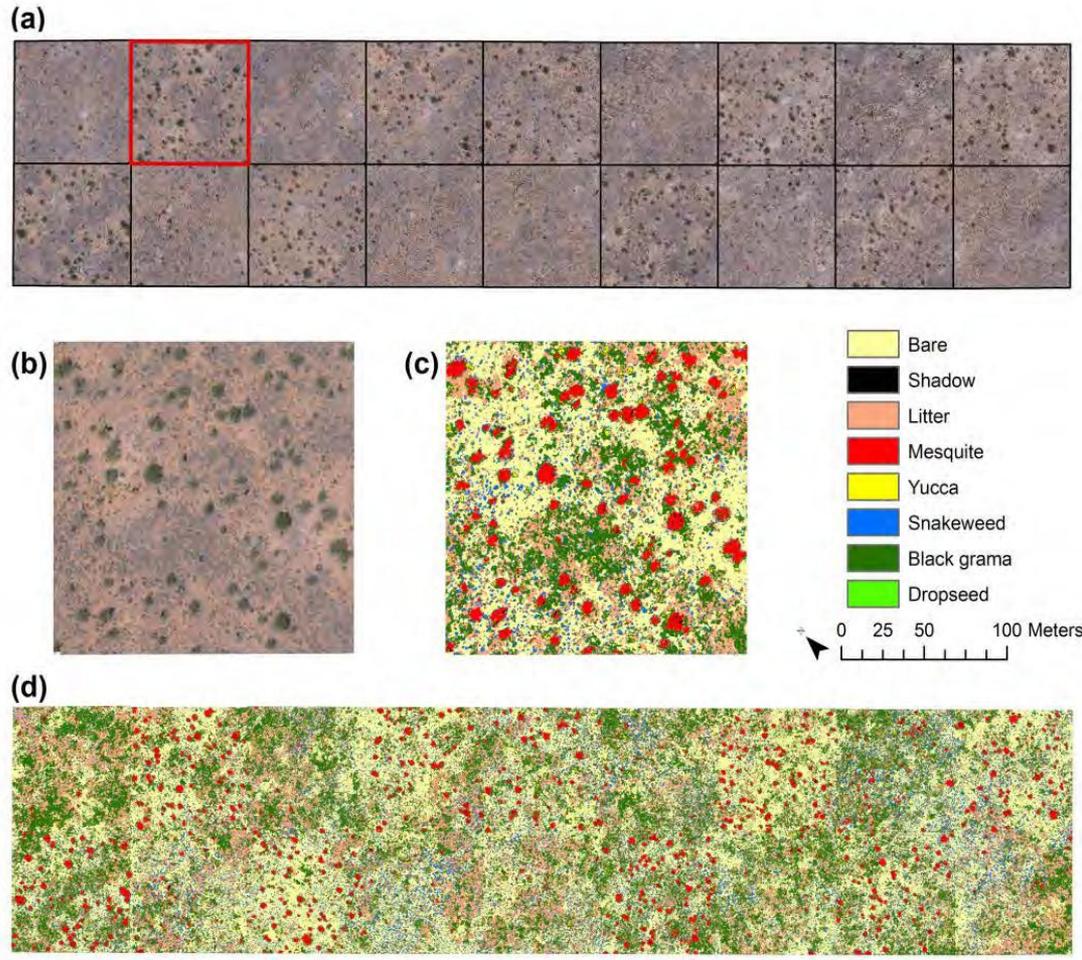
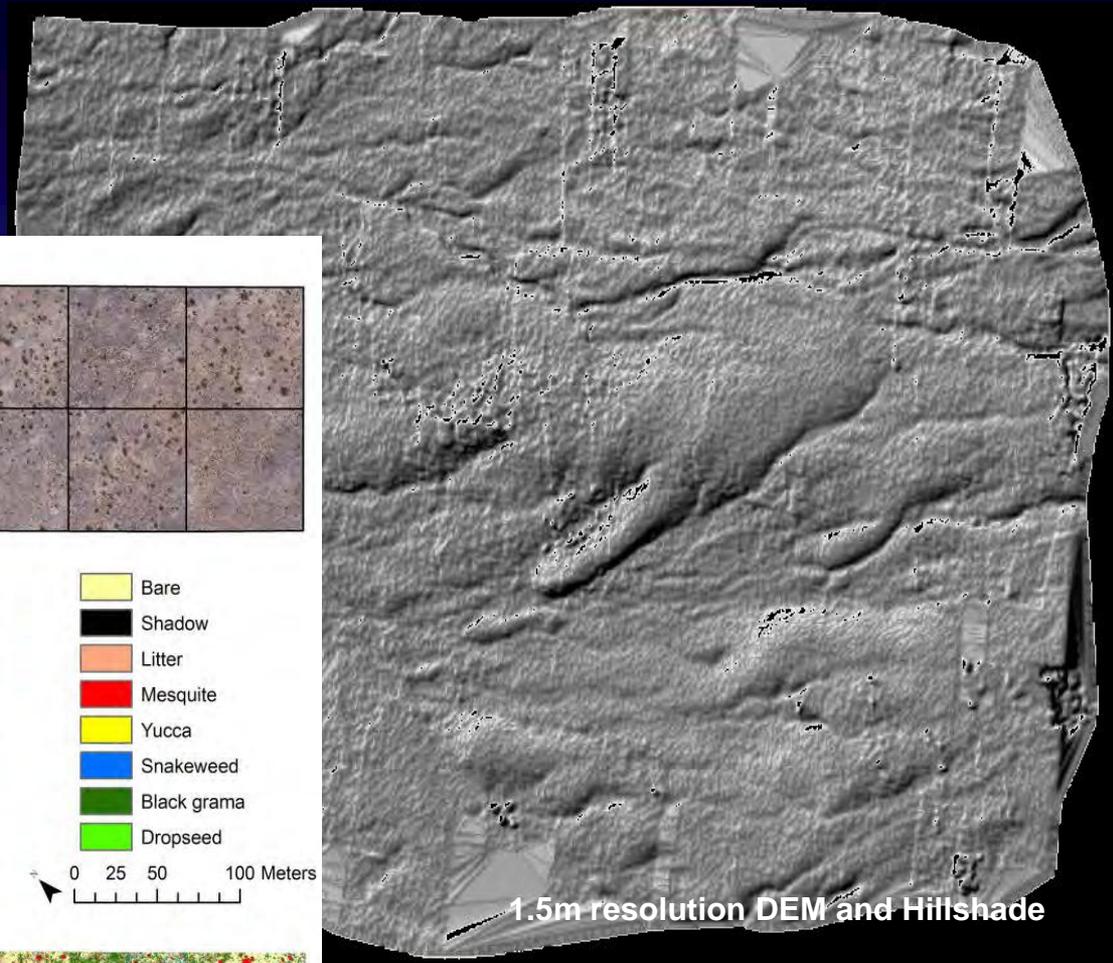


Agricultural Research Service

UAS image mosaic 135 ha, 180 images 6 cm GSD



ARS Results:



Summary

Much like Global Positioning System and Internet technology have changed the way we do business- Unmanned Aircraft Systems will transform the methods and techniques employed across the Department of the Interior and the United States Geological Survey to conduct our missions. Cost effective UAS technology is currently available to support a wide variety of applications including:

- managing federal lands
- monitoring environmental conditions and natural resources use
- analyzing dynamic earth processes
- supporting global and climate change investigations (carbon trade)
- supporting law enforcement actions
- aiding search and rescue teams
- inventory of wildlife
- generating mapping, charting, and geodesy products
- conducting environmental impact assessments
- developing an archive of observations
- preventing, preparing for, responding to, and recovering from disasters

<http://rmgsc.cr.usgs.gov/UAS/>

