

DEPARTMENT OF INTERIOR: USE OF UNMANNED AIRCRAFT IN DOI

Presented by:

Lance R. Brady

Bureau of Land Management, Department of Interior

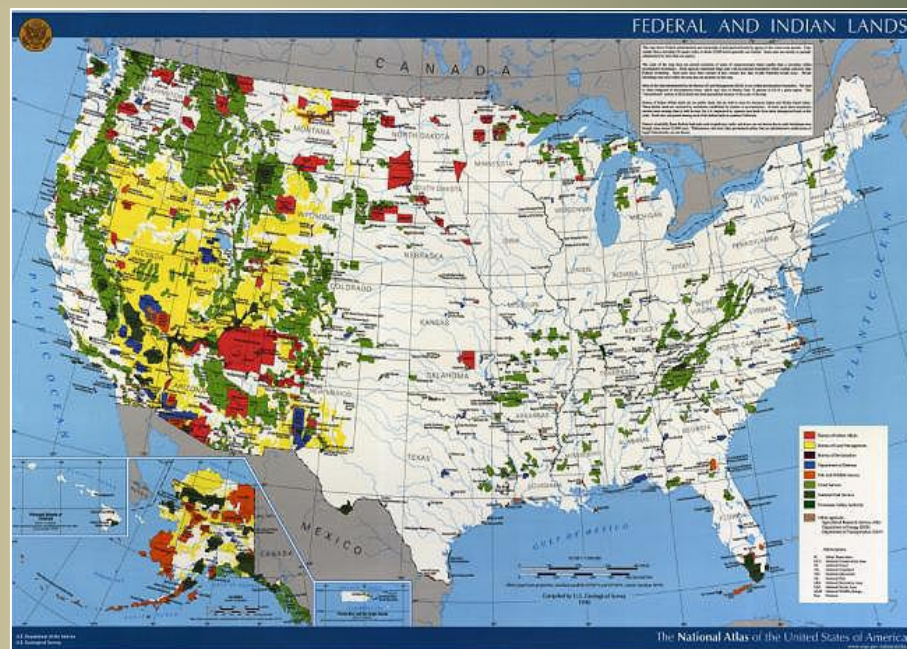
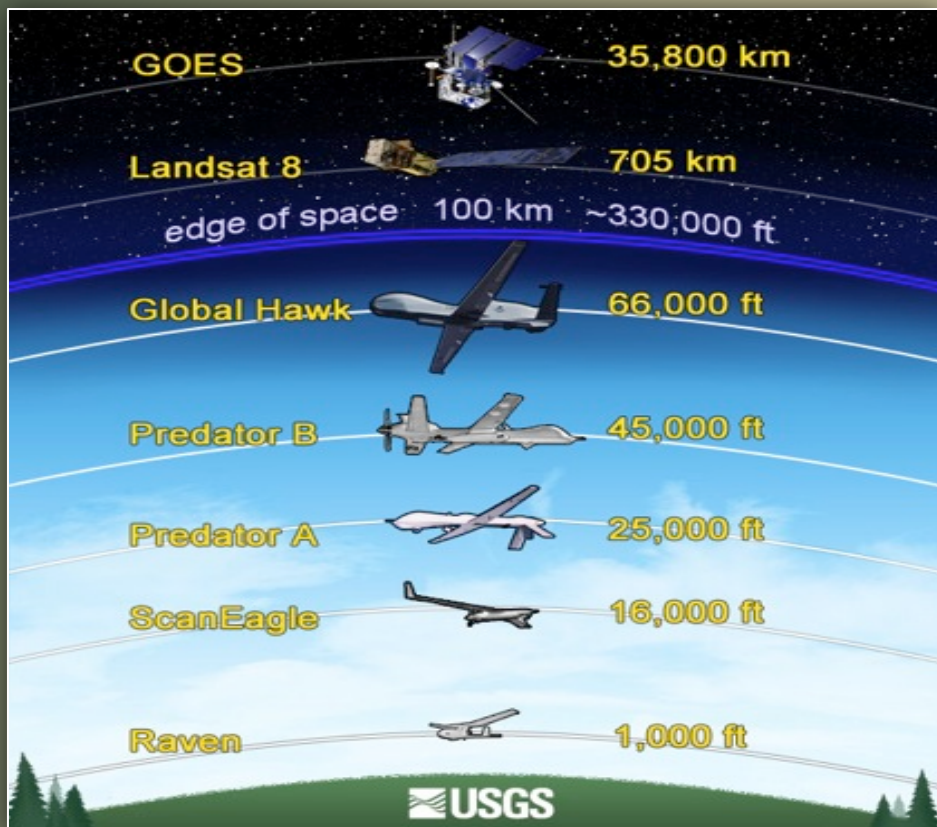
Denver, Colorado

Fire Management, Unmanned Systems

Date 04/29/14



Background



507 million acres of land - 1 out of every 5 acres in U.S. is the Dept. of the Interior's management responsibility

- B L M U A S / R C U s e 1 9 9 0 ' s
- Emerging Technology Investigation.....2005-2008
- USGS UAS National Project Office Created.....May 2008
- First Systems Acquired.....December 2009
- Operational Procedures Memorandum.....March 2010
- Operator Training/ Demonstrations/ Introduction to COA.....2009-2010
- Roadmap Released.....July 2011
- Operations.....Spring 2011
- Formal Concept of Operations.....Spring 2012
- DOI Systems.....Denver, Boise, Bozeman, Anchorage



BLM AVIATION PROGRAM

- BLM Aviation based at the National Interagency Fire Center in Boise, Idaho
- Overall program guidance from the DOI-Office of Aviation Services
- BLM National Aviation Plan
 - <http://www.blm.gov/style/medialib/blm/nifc/aviation/administration.Par.39484.File.dat/NAP.pdf>
- Coordination with DOI-Office of Aviation Services (OAS)
 - OPM 13-11 DOI Use of Unmanned Aircraft Systems (UAS)
 - DOI/FAA MOA for sUAS
- Aviation Safety
- Aviation Dispatch
- Mission support for wildfire, wild horse gathers, habitat monitoring, cadastral survey, law enforcement, aerial mapping, range survey, etc.





**Memorandum of Agreement between the U.S. Department of the Interior
and the Federal Aviation Administration Regarding Operation of Small
Unmanned Aircraft Systems in Class G Airspace**

A. Introduction: This Memorandum of Agreement (MOA) between the U.S. Department of the Interior (DOI) and the Federal Aviation Administration (FAA) sets forth provisions that will allow DOI-operated small Unmanned Aircraft Systems (sUAS) increased access to Class G airspace for public aircraft operations in accordance with applicable laws and government agency policy.

B. Scope: The policies, procedures and operations prescribed in this MOA apply to DOI sUAS operations involving scientific applications, wildlife surveys and Search and Rescue (SAR) efforts within Class G airspace at or below 400 ft AGL, authorized through Certificate of Waiver or Authorization (COA) via Notification procedures.

C. Authority: Title 49 of the United States Code (49 USC) § 106 provides the authority to the FAA to set aviation safety standards and regulate aviation operations in the National Airspace System (NAS). Title 49 USC provides the authority for government agencies to conduct public aircraft operations in the national airspace subject to certain limitations § 40125.

D. UAS Airworthiness Certification: The DOI assumes responsibility that the sUAS it will operate under this MOA are airworthy and in condition for safe operation based on the manufacturer's specifications, technical manuals and maintenance recommendations for the aircraft, control station, and associated support equipment. Where appropriate for unmanned aircraft, the aviation standards aircraft detailed in DOI Department Manuals 351 DM, Flight Operations Standards and Procedures and 352 DM, Aviation Safety shall be applied. More specific guidance is contained in DOI Operational Procedures Memorandum (OPM) No.11, DOI Use of Unmanned Aircraft Systems, and OAS Instruction 5400-202. All DOI UAS will be inspected for airworthiness and kit condition by OAS designated aircraft inspectors at the same interval as DOI manned aircraft.

E. UAS Pilot/Crewmember Qualification: The pilot in command (PIC) and flight crewmembers, including visual observers, of DOI sUAS shall be qualified in accordance with the requirements listed in the FAA UAS Operational Approval Notice N8900.227. sUAS pilots and observers are required to have an appropriate current medical exam in accordance with DOI OPM No. 11 and will be subject to annual flight evaluations administered by DOI Office of Aviation Services designated pilot inspectors. These qualifications must meet or exceed requirements listed in the FAA UAS Operational Approval 8900.227.

F. Spectrum and Associated Documents: DOI will be responsible in ensuring that the appropriate frequency spectrum approvals are obtained in advance of any sUAS operation.

Highlights:

No COA if;

- Scientific, Wildlife, SAR
- Class G Airspace
- >5NM from civil airports/heliports
- 400' AGL and below
- <55 pounds
- Visual line of sight
- DOI lands, or notification of land owners
- No ops over populated areas
- Certain limits in Mode C veil
- Night ops approved w/conditions

BLM Project Request

- Project Proposal
- Frequency Spectrum Approval
 - If needed
- COA Application and Approval
 - operations under the DOI/FAA MOA
- Project Aviation Safety Plan



Unmanned Aerial System Project Proposal

Project title: Dwarf Bear-Poppy Unmanned Aerial System Mapping

Submitted by: Marisa Manger, GIS Specialist, St. George Field Office Utah (435) 688-3288, mmanger@blm.gov

Project and Geographic Area Description: This project proposes to use high resolution imagery collected by an unmanned aerial system (UAS) to map habitat extent and populations of the dwarf bear-poppy (Artemisia tridentata). The dwarf bear-poppy is an endangered native plant that grows only in southern Washington County, Utah and only on highly erodible gypsum soils with intact micro-biotic soil crusts, thus severely limiting its range and habitat. In 1989 the St. George Field Office designated approximately 4,300 acres of public lands, located west of the rapidly growing cities of Bloomington, Mo., Santa Clara, and St. George, as the Red Bluffs Area of Critical Environmental Concern (ACEC), to provide special protections for the dwarf bear-poppy populations and habitat that were found on these lands.

Determining the true extent of the plant populations and monitoring the impacts on their habitat in this ACEC has proven to be challenging, as pedestrian data collection methods compact the fragile gypsum soils, damage the biological soil crusts, and create trails that channel water and increase soil erosion. The use of UAS technology to generate high resolution imagery could prove to be a non-invasive and cost effective method to determine the extent of plant populations and current habitat conditions, providing geo-referenced images of vegetation for the ACEC. This imagery could be used to guide management actions and determine the locations of needed protective measures that would assist the recovery of this critically endangered species. The project work must be targeted for late April or early May, when the white flowers of the dwarf bear-poppy would visually contrast with the red-orange colored soil of its habitat, creating optimum conditions for imaging.

Objectives: To test techniques and capabilities of the fixed winged aerial system (UAS) at various altitudes for mapping the occurrence of an endangered plant species and the conditions of its habitat. The proposal would evaluate the potential of this technology to accomplish the resource objectives and identify the best methodologies to achieve the goals. Once the best methods have been determined, additional UAS surveys would be planned, with an overall goal of a GIS vector data set to be used for planning future management actions.

Time Sensitivity: Project work would need to be conducted during the spring flowering period for the dwarf bear-poppy, when its white blooms would contrast with the background soil color. The spring flowering timeframe may vary slightly, depending on the amount of precipitation received during the winter months, but generally would occur during the last week of April or first week in May.

BLM Offices Involved: St. George Field Office, Cedar Country District, Utah

Partners or Cooperators: None

BLM Program Subjectivity and Program: 1010, 1110, 1610

Cost estimate: \$5200 - estimate includes \$3,000 in travel cost for UAS Pilots and \$200 in supplies for flight operations. Imagery analysis will be completed by BLM, in house.

Funding: Fully Funded

Line Officer Approval: Yes

12/28/2012

***** UNCLASSIFIED *****
SPECIAL HANDLING

Radio Frequency Authorization

This Authorization is granted pursuant to Chapter 1 Part 1.1 Section 6.1 of the NTIA Manual by authority of the US Department of the Interior.

This Authorization expires on: **November 1, 2013.** For continued use of this equipment, YOU MUST SUBMIT a request to your Frequency Manager by August 03, 2013.

Serial Number	FCI	MSD	BUR	NET	RVD	AUS	EXD
1 120077	X		0	BLM	121217	2047788	121101
FRQ	RIN	TWE	SPD	STC	Bandwidth	Emission	Power
890.05 MHz					15.40 kHz	F1D	2 Watts (e)
XAL, XSC				XRC	XLA, XLG	XCL	XAP, XAZ
TUCDOR, AZ				UAS	21874001110004W	V	RD
XAD							
COORIP							
RAL, RAC				RRC	RLA, RLG	ACL	RAP, RAL
TUCDOR, AZ					21874001110004W	V	RD
RAD							
COORIP							

Remarks
 *RAD, 0005
 *RRL, 00002, 0001
 *G2, G, N, F, Q, H, 151A
 *MPT, ATR OPERATIONS
 *CPT, 0001
 *AGN, ASSOCIATED W/MLR10, 0000, 2 120076
 *AGN, CHD-120110008
 *AGN, FLM-100, 000004
 *PTE, H115, DRAC-24274/1, 2PP-14097

Restrictions (NTS, NTS, SUP)

R405 - This note is not in the current list of approved record notes.

H015, DRAC-24274/1, 2PP-14097 - THE SYSTEM USING THIS ASSIGNMENT WAS REVIEWED BY TM IN ACCORDANCE WITH CHAPTER 10 AND THE ASSIGNMENT IS BEING MADE SUBJECT TO COMPT STATED IN THE DRAC AND SUP DOCUMENTS REFERENCED IN THE CIRCUIT REDUNDANT FIELD-10

Supplementary Details: - FREQUENCY SUPPORTS PRIMARY DAY CONTROL, UPLINK, DAY OPEN, MPT, DRONE, DAY, SCHEDULE, VISIBLE TO OTHER AIRCRAFT WHEN IN FLIGHT. COORDINATION AND SCHEDULING WITH LOCAL ATC FACILITY AND INSTALLATION FREQ MGR REQUIRED. TO ADDRESS HEALTH SAFETY RISK HAZARD DUE TO HEAVY METALS PLANNED OPERATIONS USE JMW 1 - FEB AND SEP 1 - NOV 1, 2012. 2009 WRECKER FOR LANCE W. SWARTZ CELL 920-945-6549. DOI ON JOINT USE REFERENCE AR 046249.

SPECIAL HANDLING
***** UNCLASSIFIED *****

AIR OPERATIONS PLAN For Unmanned Aerial System (UAS) BLM Gila District

PREPARED BY: Mar Hays DATE: _____

TITLE: Unit Aviation Officer, Oila District, BLM

REVIEWED BY: _____ DATE: _____

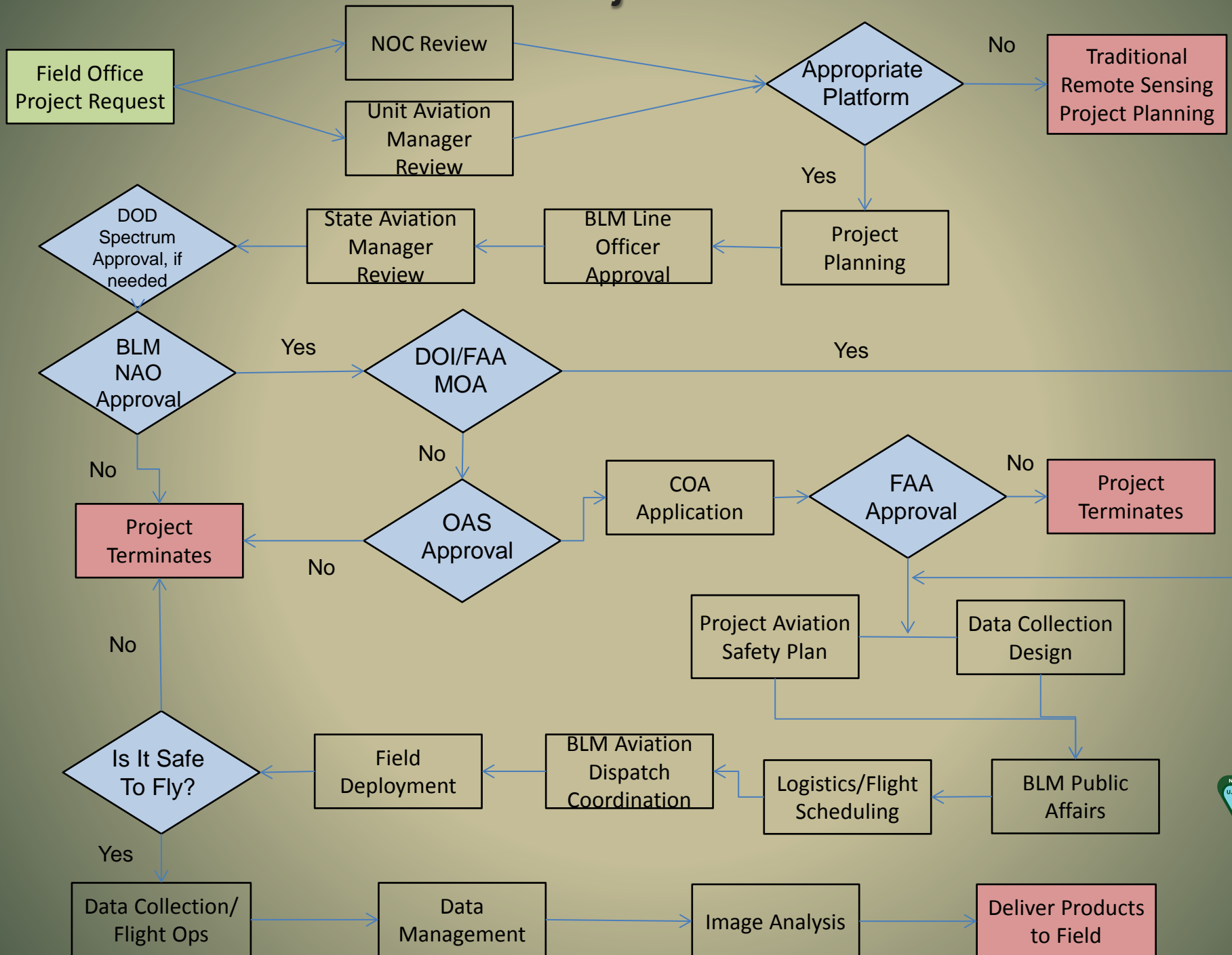
TITLE: State Aviation Manager (SAA)

APPROVED BY: _____ DATE: _____

TITLE: District Field Office Manager



BLM UAS Project Workflow



RQ-11A Raven

- 4.2 lb, 36 inch long, battery-powered single engine fixed wing
- 10 km range, 90 min endurance, 30 mph
- EO/IR Sensor
- 19 systems, 3 aircraft per system, 57 total Raven A
- Migration to Raven B in 2014





RQ-16 T-Hawk

- 20 lb, 21 inch wide, gas-powered single engine ducted fan VTOL
- 10 km range, 47 min endurance, 45 mph
- Gimbaled EO/IR Sensor
- 22 systems, 2 aircraft per system, 44 total T-Hawk
- As of 02/21/14 all aircraft are grounded due to military radio



Sample DOI UAS Applications

Wildlife Management

- Migratory Birds-
 - Sandhill Cranes, Whooping Cranes, Trumpeter Swans, Geese, Ducks
- Pygmy Rabbit, Fish Habitat
- Large Animals
 - Grizzly Bear, Elk, Big Horn Sheep, Wild Horses, Mule Deer, Goats, Wild Hogs
- Sage Grouse Inventory
- Sea Turtles
- Eagle & Swan Nest

Public Safety

- Abandoned Mine Lands (AML)
- Coal Seam Fire Detection
- Wildfire Incident Support
- Monitor Volcanic Activity
- Monitor Landslides
- Flood Mapping
- Search and Rescue
- Dam- Levy Inspections
- Hunting Regulation Enforcement
- Law Enforcement Support

Inspections- Mapping

- Fence, Pipeline, Powerlines
- Mine Reclamation
- Riparian Zone Surveys
- Vegetation – Invasive Surveys
- Archeological Site Surveys
- Environmental Survey- Palmyra Atoll
- Damage Assessments
- Easement Verification
- Volumetric Calculations
- Geologic Mapping
- Outreach –media- marketing

Earth Science Research

- Assess Impacts of Dam Removal
- Hydrographic Surveys
- Fire Science Research
- Monitor Forest & Rangeland Health
- Erosion Studies
- Rupture Zone Identification
- Geologic Resource Mapping
- Climate Change
- Sensor Research
- Image Processing Research



Upcoming BLM Missions

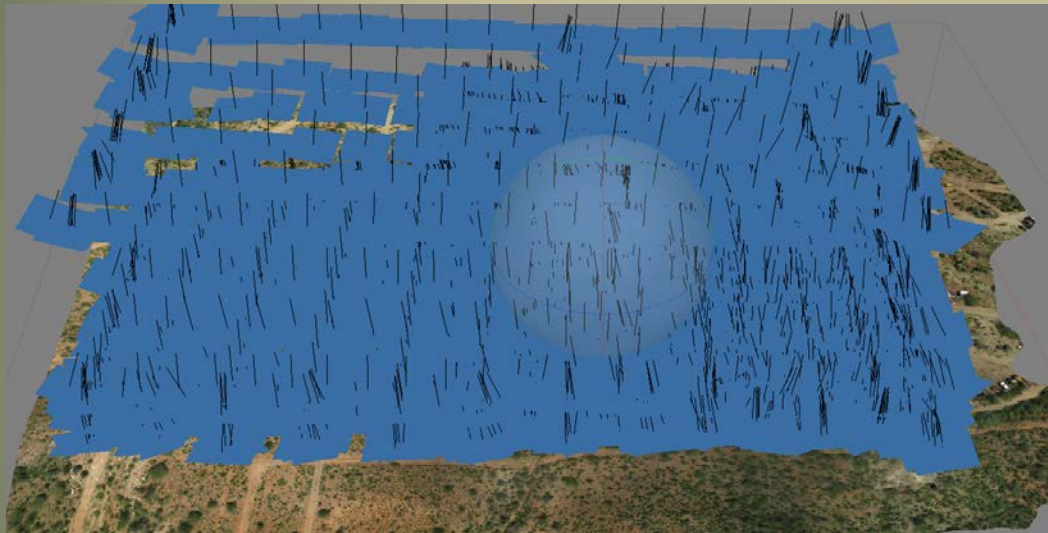
- **Alaska**
 - National Petroleum Reserve – AIM project
- **Arizona**
 - Dogtown Mine AML/Hazmat
 - Silver Creek Hydro Project
 - San Simon Watershed
 - Yuma Geoglyphs Prehistoric Project
- **California**
 - Northern California AIM project
 - Camp Iron Mountain Cultural Project
- **Colorado**
 - Canon City Gravel Pit Volumetric
 - Grand Junction Gravel Pit *
 - I-70 Landslide*
 - South Canyon Coal Seam Fire
- **Idaho**
 - Upper Snake Field Office Invasive Weeds
 - Lower Salmon Prehistoric Survey
 - Snake River Cadastral
 - Post-Fire Rehab (OWF) *
- **Montana**
 - Miles City Coal Seam Fires
 - Big Bend ACEC Prehistoric Survey
- **Nevada**
 - Caliente Field Office Cultural Survey
- **Oregon**
 - Seed Orchard Survey
- **Utah**
 - Caliente Nevada Cultural Survey*
 - Henry Mountain AML



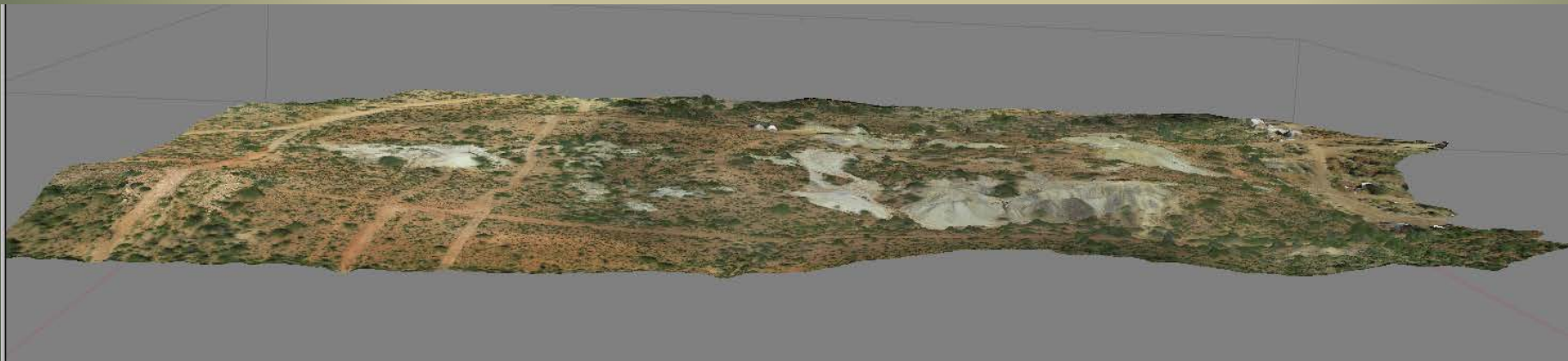
Dogtown Mine Site

Tucson Field Office, Arizona

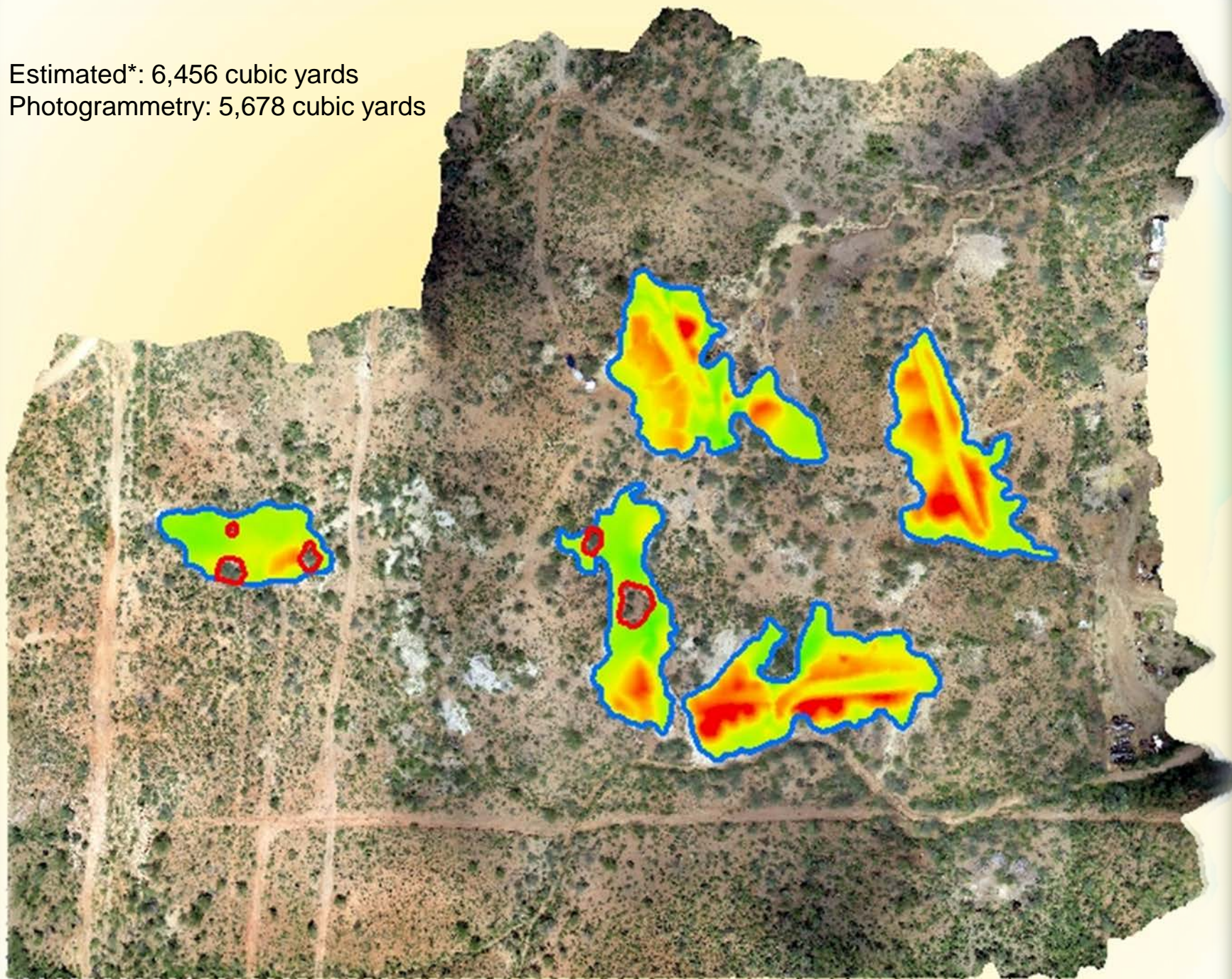
September 2013



- BLM CERCLA authority
- 30 acre site contaminated with heavy metals including; lead, arsenic, antimony and mercury
- Volumetric calculation on hazardous material piles
- Flights also included documenting new AML sites
- Flights included flights at 50' – 150' AGL
- 3547 individual stereo camera locations



Estimated*: 6,456 cubic yards
Photogrammetry: 5,678 cubic yards



* BLM Tucson Field Office, Dogtown Mine Site CERCLA Evaluation Report

Elwha Dam Removal and River Restoration

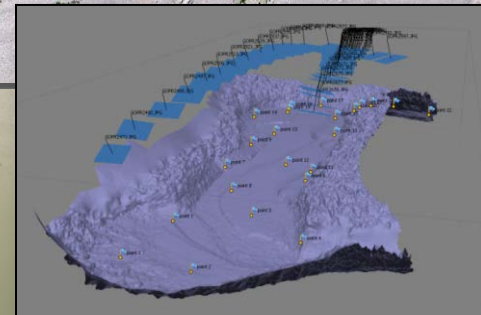
Olympic National Park, Washington

BLM

National Operations Center



Monitoring sediment volumes eroded from the reservoir and deposited downstream, where the mobile sediment can potentially affect salmon habitat and flood-stage elevation.



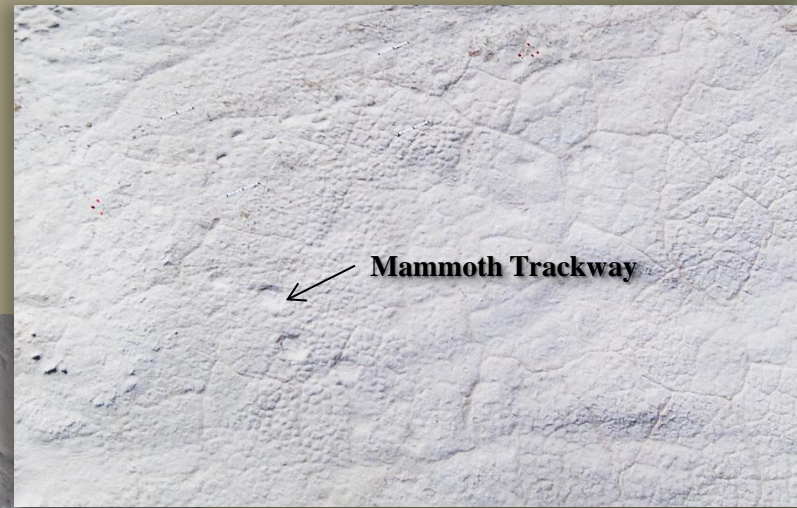
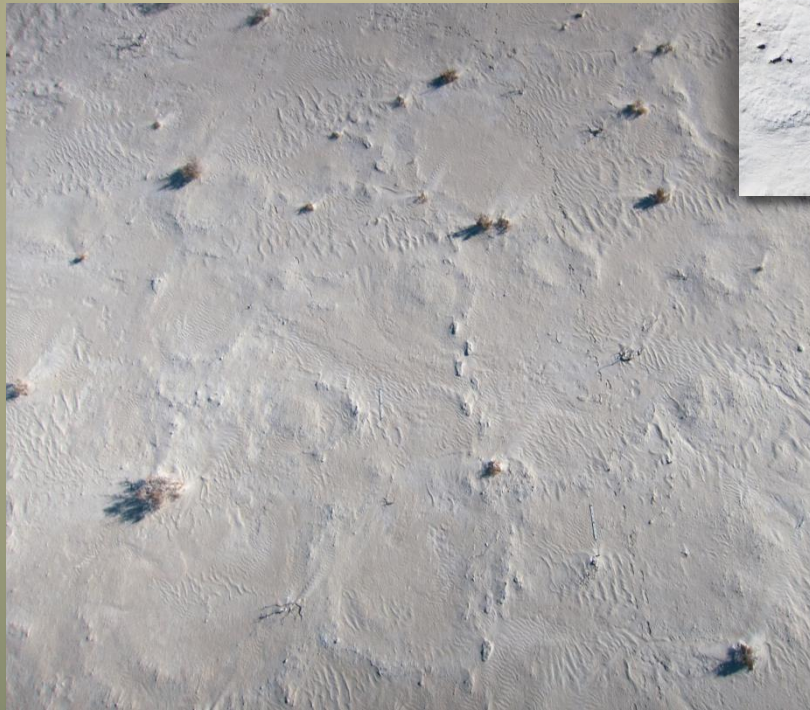
Pleistocene Trackway Mapping

White Sands National Monument, NM Jan 6-10, 2014

BLM

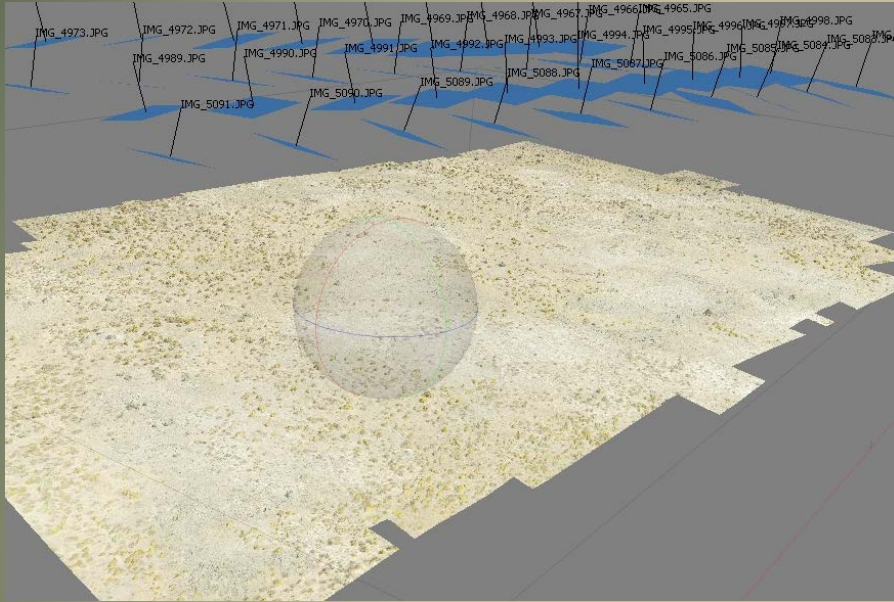
National Operations Center

Photogrammetric documentation using a UAS to aerial survey extremely fragile fossilized footprints from the late Ice Age.



Invasive Rush Skeletonweed

Upper Snake Field Office, Idaho
August 2013



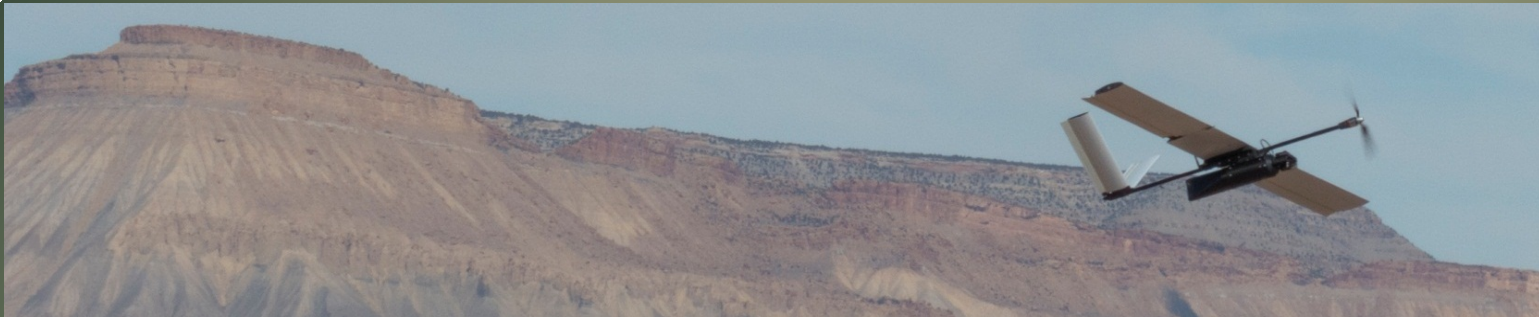
Mine Inspections

West Virginia – First T-Hawk Mission in the NAS – Nov. 2012



Mine permit inspections monitoring a range of topics: water quality, hazardous conditions, terrain topology, wildlife habitats, erosion, check dams post mining land use, and safeguarding cultural features.





BLM/Mesa County, Colorado Sheriffs' Cooperation

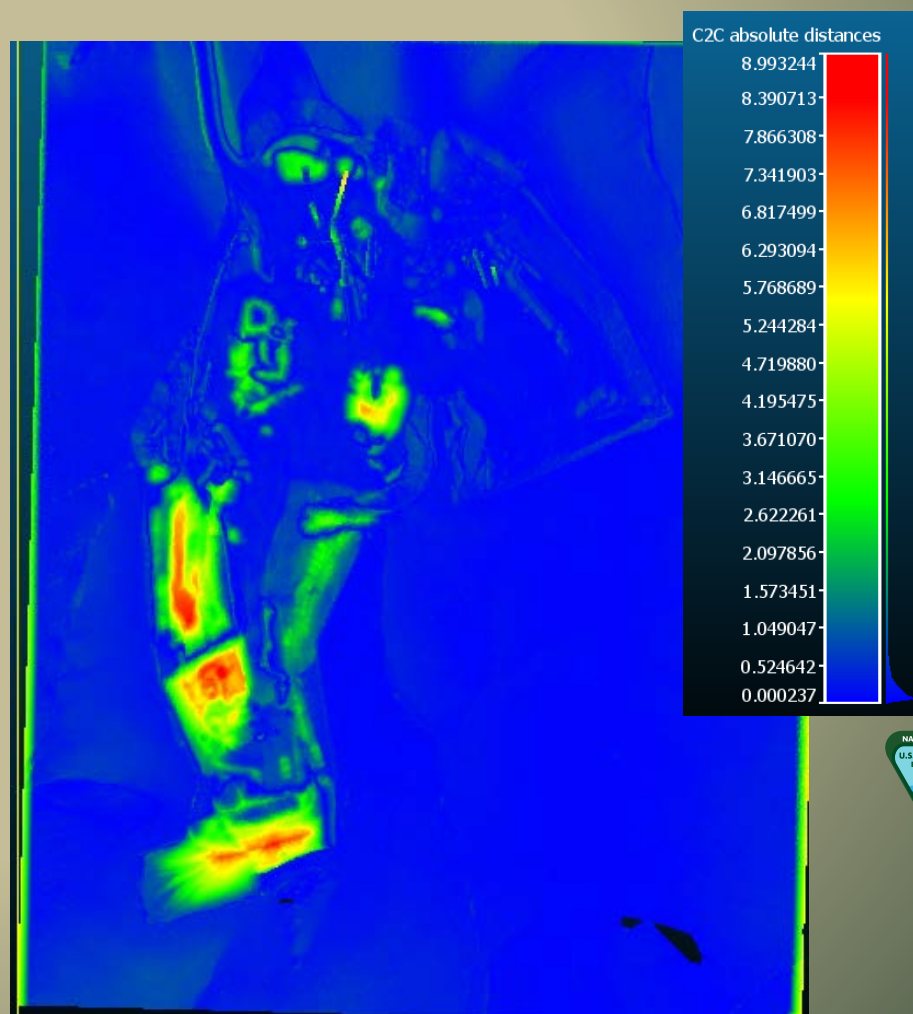
- Flown under Mesa County wide COA
- Multiple Project flights including gravel pit volumetrics, landslide monitoring and dinosaur quarry mapping
- BLM/County flight over gravel operations, volumetric compliance inspection;
 - Traditional Aerial: \$10,000
 - UAS Mission: \$120
- County flight over landfill, volumetric calculation
 - Traditional Aerial: \$10,000
 - UAS Mission: \$300



DEM Hillshade



Orthophotography

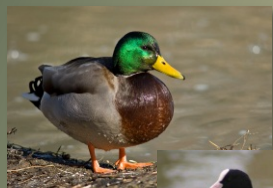


Dense point cloud with RGB values



Waterfowl & Habitat Surveys

Ruby Lake, NV – Kern/Pixley, CA – Tomalas Bay, CA








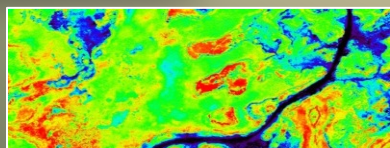
Generating a census for waterfowl populations and determining individual species. Developing an UAS image library for waterfowl identification and mapping habitat.



From 1937 to 2000, 66% of all field biologist fatalities in DOI were aviation-related.



15 cm ZOOM					
Elevation (MASL)	158	138	120	102	85
M above ground	90	70	52	34	17
Ft above ground	295	229	170	112	56
Mallard					



Debeque Landslide

Debeque, Colorado



June 2013



Oct 2013

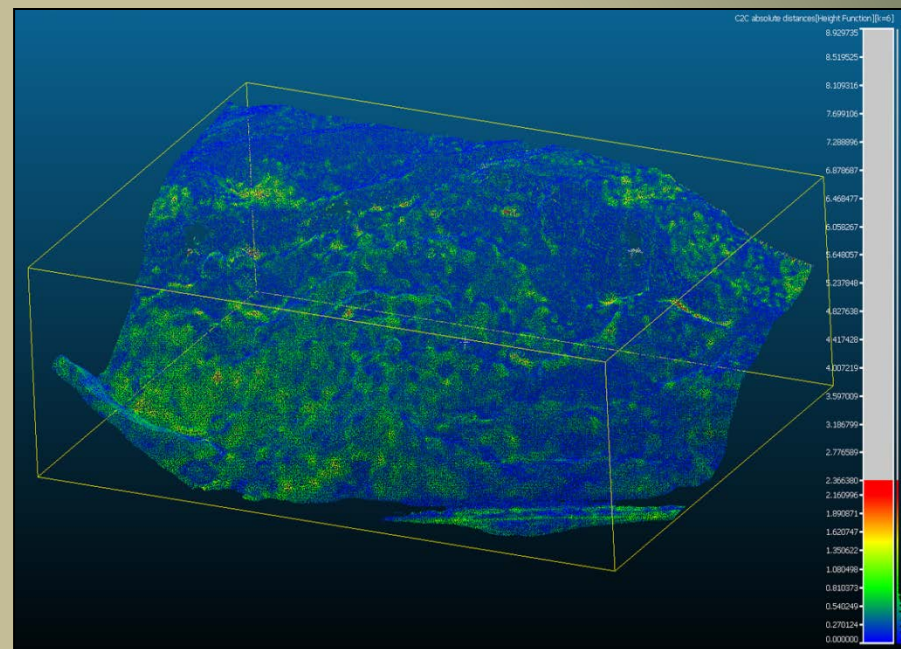
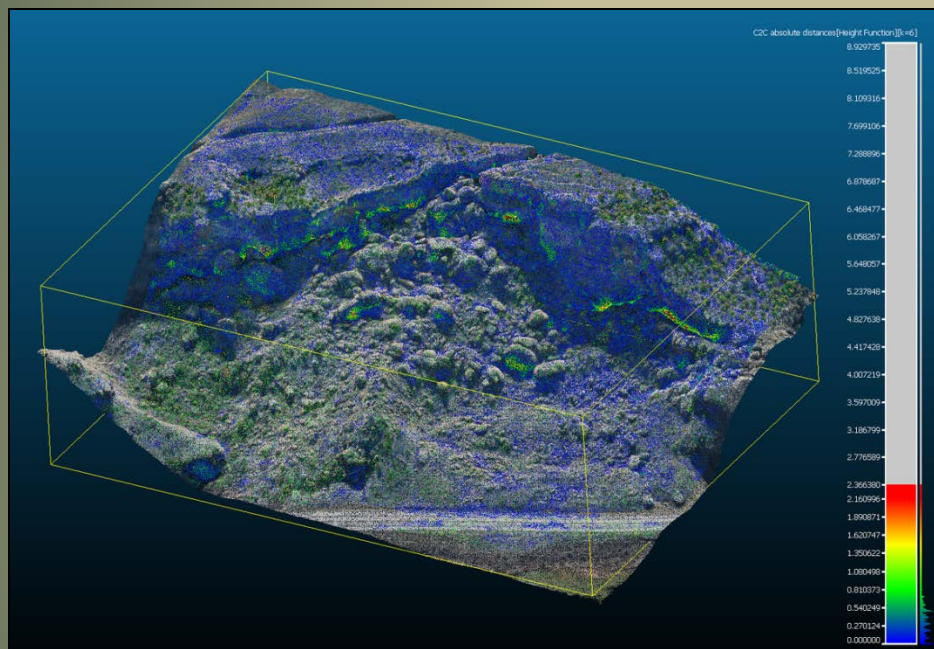


Temporal series of Landslide models monitoring geomorphic processes.



Debeque Landslide

Debeque, Colorado



Point cloud comparison and calculations using Cloud Compare



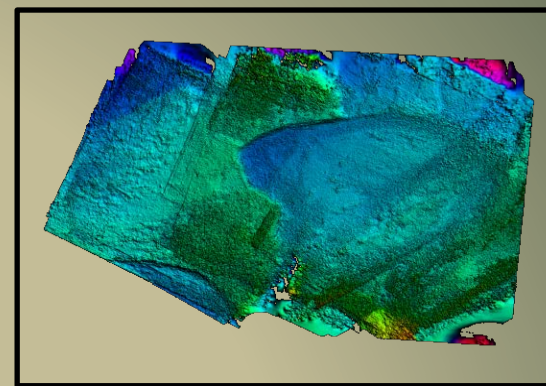
Geospatial Data



FULL-MOTION VIDEO



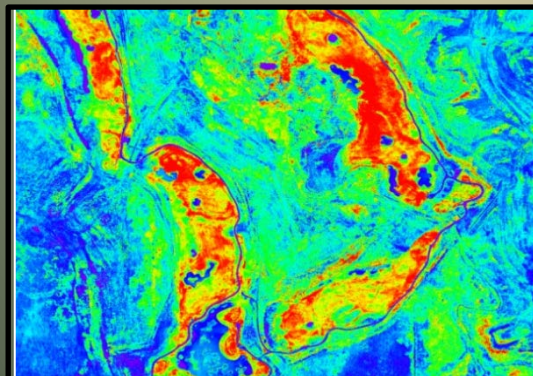
3-D POINT CLOUD DATA



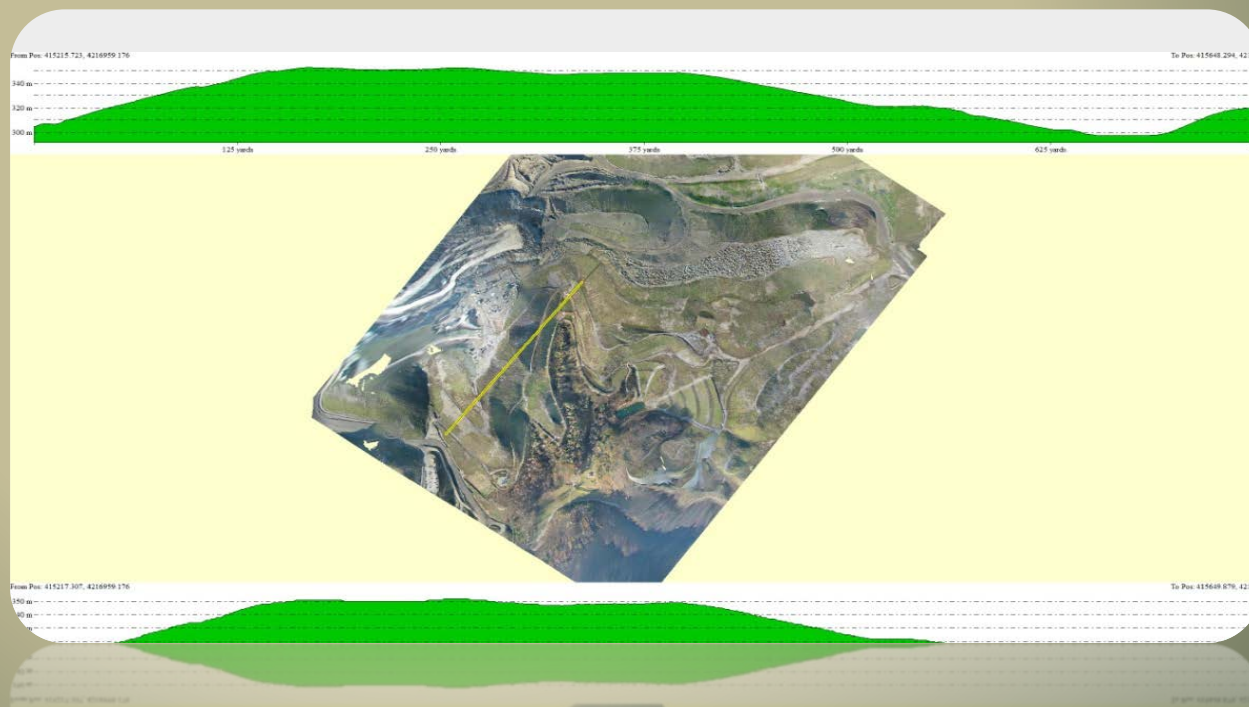
ELEVATION MODELS



ORTHOIMAGERY



CLASSIFICATION and NDVI



Future

- Updated DOI/USGS UAS RoadMap
- New, better, more versatile, lower cost UAS platforms
- Work on airworthiness standards acceptable to FAA and OAS
- Working with Universities to stay up on latest technology
- DOI contract mechanism for tapping other UAS technology
- Continue to support proof-of-concept missions
- More emphasis on the end data products vs. the platforms



Questions?

BLM Contact Information:

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Jeff Safran, GIS

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DOI/USGS UAS Project Office: UAS.USGS.GOV