



U.S. Geological Survey – UAS for Research & Applied Science

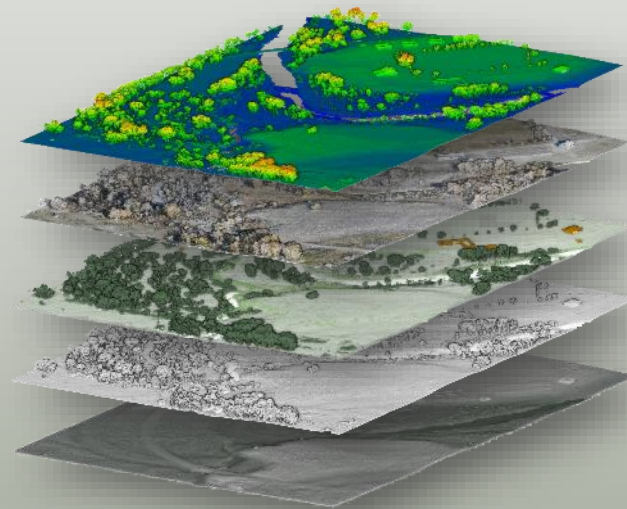
Department of the Interior
U.S. Geological Survey
National Uncrewed Systems Office

Website: uas.usgs.gov



@USGS_UAS

FY 2022

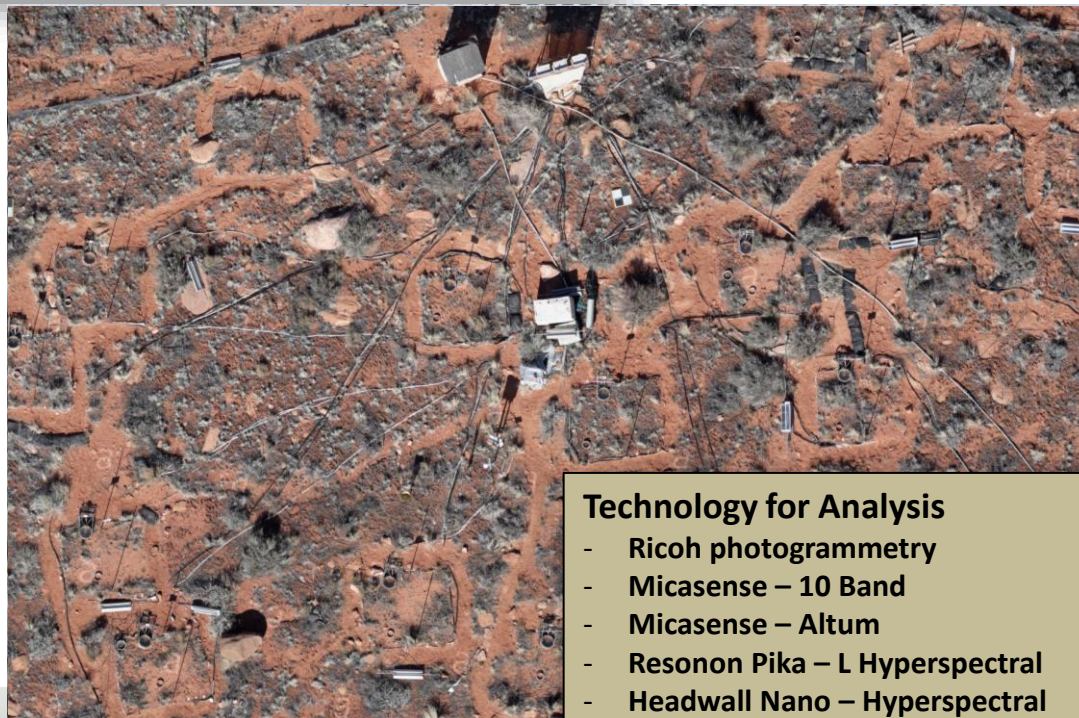
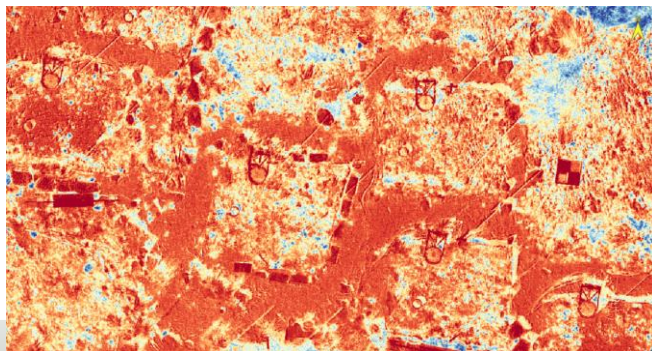
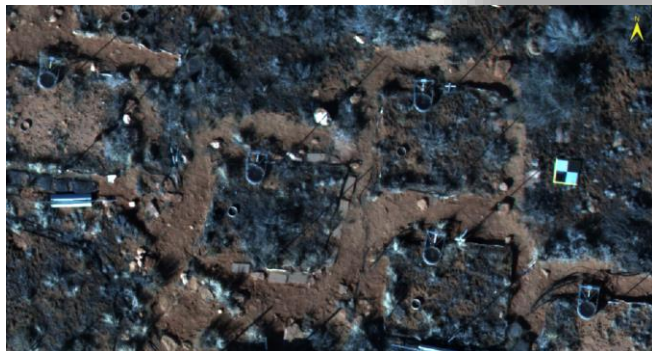


Sasha Reed Video



USGS – Moab Biocrust (2022)

USGS/University of Arizona – Moab, Utah



Technology for Analysis

- Ricoh photogrammetry
- Micasense – 10 Band
- Micasense – Altum
- Resonon Pika – L Hyperspectral
- Headwall Nano – Hyperspectral
- XT2 EO/IR

Experimental test data for information purposes only



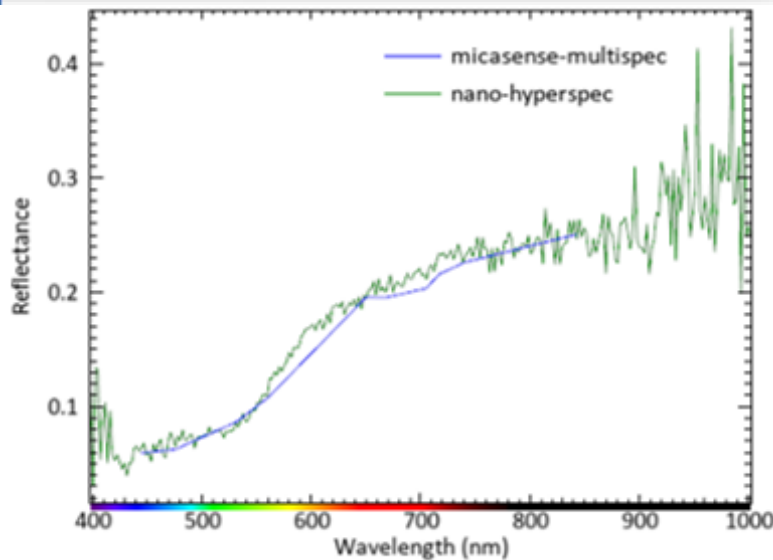
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USGS – Moab Biocrust (2022)

USGS/University of Arizona – Moab, Utah



10-band Micasense



274-band Headwall Nano

Comparing **multispectral** and **hyperspectral** reflectance profiles

USGS National Uncrewed Systems Office – Sensor Integration

Headwall Nano Hyperspec



Resonon Pika L



Spectral Range (nm)	400 – 1000
Spectral Resolution (nm)	1.3
Spectral Channels	447
Spatial Channels	1600
Max Frame Rate (fps)	165
Bit Depth	12
Weight (lb/kg)	4.9 / 2.2
Dimensions (cm)	10.1 x 27.5 x 7.4
Connection Type	USB 3.0
Operating Temperature (°F/C)	41-104, 5-40
f/#	2.4
Pixel size (μm)	5.86
Avg. RMS Spot Radius (μm)	6
Smile (peak-to-peak) (μm)	4
Keystone (peak-to-peak) (μm)	5

Sensor integrations are presently still in development



USGS National Uncrewed Systems Office – Sensor Integration

Palo Alto, California Biofilm Resonon Pika-L Project (May 2021)



Sensor integrations are presently still in development



USGS Innovation Center Proposals – Software Defined Radar

(Sept 2020)

Winter Park, CO

Dr. John Fulton, USGS

Mr. Sam Prager, USC

USGS NUPO



UAV-based software-defined radar sensors for environmental monitoring



USGS Innovation Center Proposals – Software Defined Radar

(April 2021)

Winter Park, CO

UAV-based software-defined radar sensors
for environmental monitoring

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Simultaneous Lidar Data Collection



Four separate systems to collect
imagery, radar and lidar

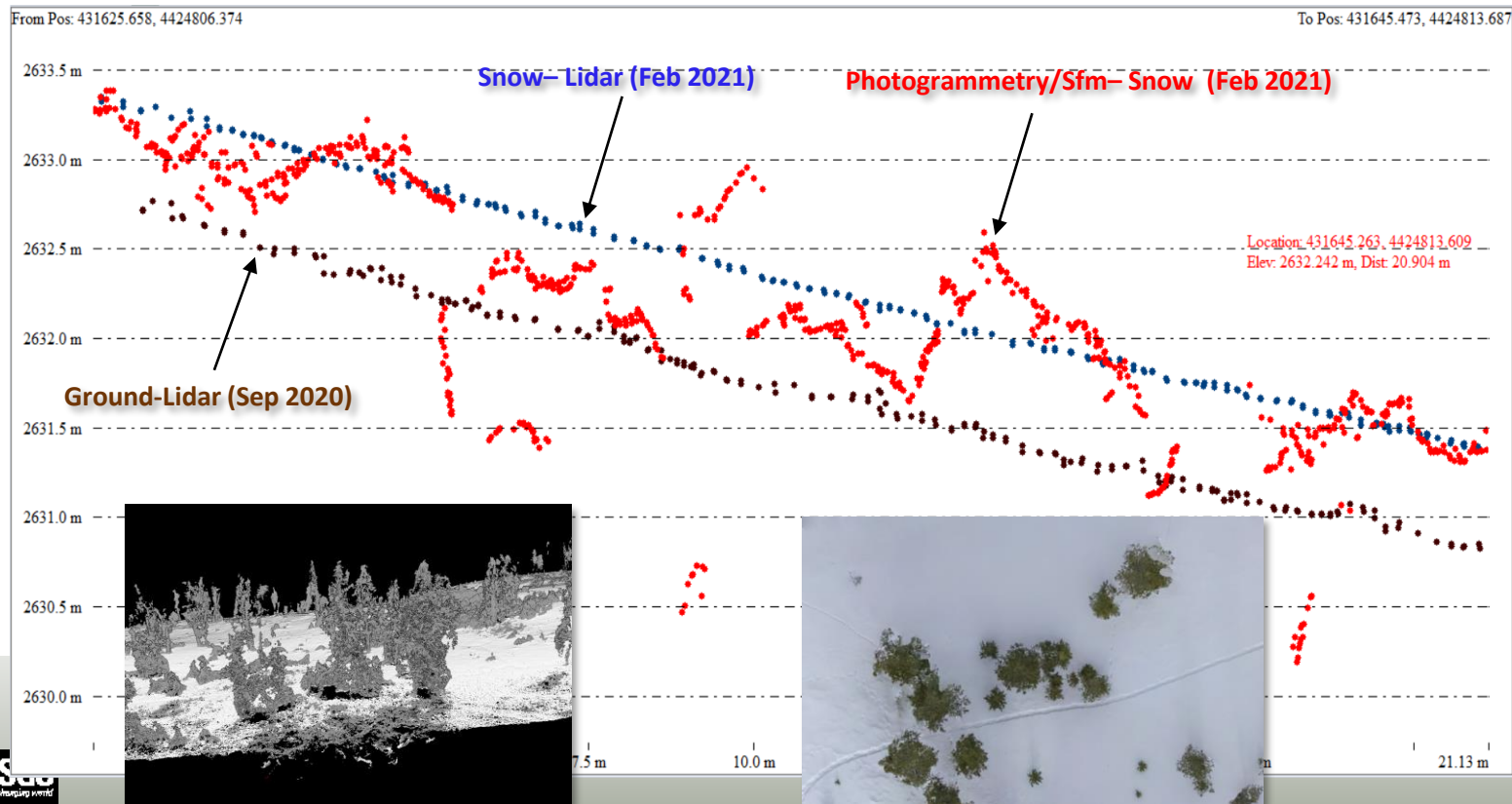


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USGS Snow Water Equivalent Project – UAS Lidar

Devils Thumb Ranch - Lidar vs Sfm a Snow Depth Comparison

From September 2020 to February 2021



USGS Innovation Center Proposals – Wildfire Smoke Plume Sampling (EPA)

(April 2021)

Konza Prairie, KS



USGS Innovation Center Proposal - Environment Protection Agency



Kolibri Sensor

Smoke Plume Sampling (EPA) (August 2022)

Poker Flats, Alaska



Partners

- University of Alaska Fairbanks – Research Range
- Bureau of Safety and Environmental Enforcement (BSEE) – Oil Spill Response
- Environmental Protection Agency (EPA) Aerial Sampling Team
- USGS NUSO – UAS Flight Operations Team flying Kolibri Sensor
- NOAA – Smoke Plum Dispersion Modeling
- U.S. Coast Guard – National Strike Force – Pacific Strike Team – Typhoon UAS
- International Arctic Research Center (UA-Fairbanks) Thermal UAS Skydio
- Alaskan Clean Seas oil burn logistics and operations



USGS – Post-Wildfire Fire Severity (2021)

Office of Wildland Fire – East Troublesome Fire Colorado



Technology for Analysis

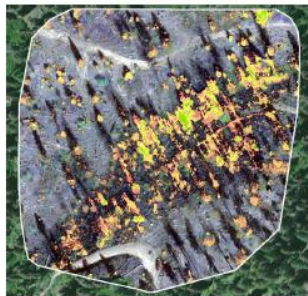
- Ricoh Photogrammetry
- Yellowscan VX-20 Lidar
- Micasense 10 band MS

Experimental test data for information purposes only



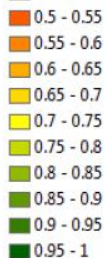
UAS Imagery Mapping Products

Vegetative Indexes

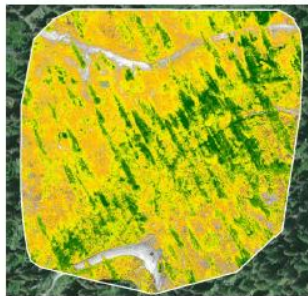


Normalized Difference Vegetation Index

□ No Data

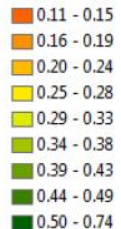


(NDVI) is an index of plant "greenness" or the amount of chlorophyll

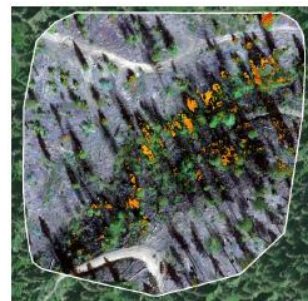


Normalized Difference Red Edge

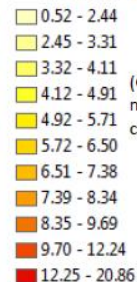
□ -0.09 - 0.10



(NDRE) is sensitive to chlorophyll in leaves and soil background

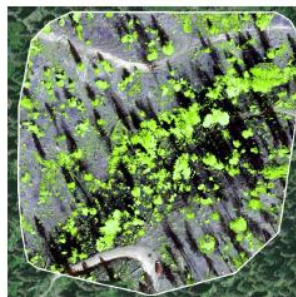


Green/Red Vegetative Index

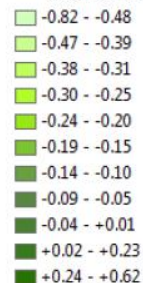


(GRVI) is an index that is more sensitive to forest canopy health conditions

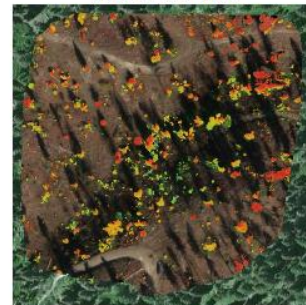
(GNDVI) is an index that detects photosynthesis activity in plants



Greenness NDVI



Chlorophyll/Optimized Soil Vegetation Burned Area Index



Slide provided by : Craig Thompson – DOI/OWF
Experimental test data for information purposes only



USGS – Slackwater Harbor Analysis (2021)

Corp of Engineers/USGS – Dardenelle Arkansas



- Collection at 5 m/s at 61m AGL
- QA/QC RMSE 0.03m based on photogrammetric point cloud and 12 Aeropoint GCP's corrected to Trimble R8 Base
- Photogrammetric collection used for colorization and QA/QC of the lidar point cloud

Technology for Analysis

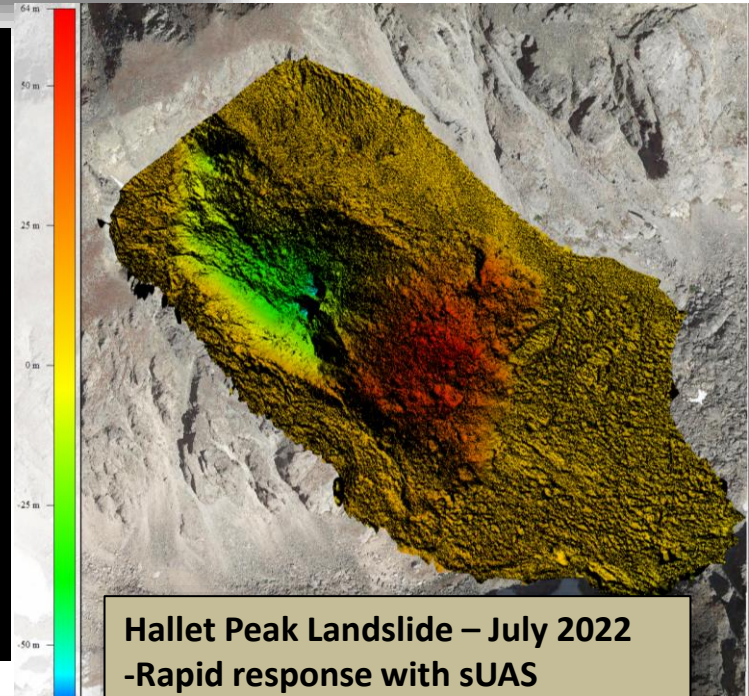
- Ricoh photogrammetry
- Yellowscan VX-20 lidar
- Multibeam sonar bathymetry survey



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USGS – Natural Hazard Rapid Response (2022)

Rocky Mountain National Park – Colorado



Hallet Peak Landslide – July 2022
-Rapid response with sUAS
-Quick photogrammetric model
-Pre/Post DEM analysis

*Experimental test data for information purposes only
USGS Geologic Hazards – Frank Rengers*



USGS National Uncrewed Systems Office

Stratospheric Micro Balloon Remote Sensing Pilot: Urban Sky



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- Mission Objectives
 - Accurate pre-flight trajectory modeling
 - Remote, mobile flight system launch with minimum personnel
 - Targeted, broad-area, gap-free ~10cm GSD imaging from the stratosphere, ~16 sq. km AOI within East Troublesome Burn Scar 2020
 - Active and targeted termination, descent and soft landing of the flight system
 - Post-processing of the data per the USGS/NUPO Specifications
- Marketing
 - Starting at \$5 per sq.km for new tasking
 - ~10cm GSD 3-band aerial imagery
 - Working on multispectral and thermal payloads

Graphics and Photographs Courtesy of Urban Sky

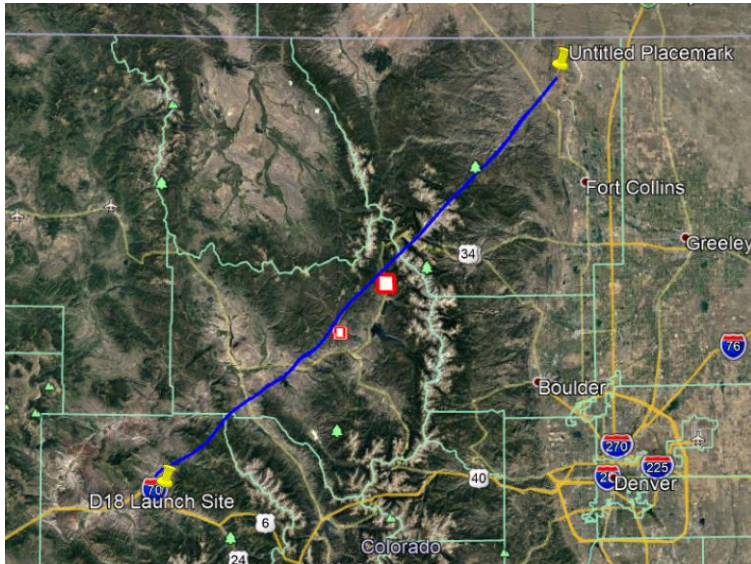
Experimental test data for information purposes only



USGS National Uncrewed Systems Office

Stratospheric Micro Balloon Remote Sensing Pilot: Urban Sky

- October 11, 2021 USGS Flight
 - Launch Time: 7:48am MT
 - Launch Location: A public, dirt road on BLM land just north of Wolcott, Colorado
 - Total Flight Duration: ~3 hours and 8 minutes
 - Distance Covered: ~177km (~109 miles)
 - Amount of area we **would've** imaged (if payload was functional): ~2,000 sq. km
 - System Landing Time: ~10:55am MT
 - System Landing Location: In a remote, unpopulated area ~10km (~6 miles) North of Livermore, Colorado (commanded and controlled, targeted descent).
 - Hardware Status after Mission: The payload was recovered with no noticeable damage.



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Graphics and Photographs Courtesy of Urban Sky



USGS – Future

- DOI and USGS are moving to our 4th generation of UAS
 - Due to concerns with cybersecurity, policies are in place to move to USA friendly manufacturers
 - USGS has begun to procure systems currently on the Defense Innovation Unit (DIU) Blue sUAS Cleared List
 - Time to get back to normal ops
- Integration of existing sensors onto new 4th Gen systems
- Contracting Services
 - Contractors will need to be mindful of current Department of the Interior Secretarial Order and the 2021 Presidential Executive Order. There is also pending legislation that could impact contracting
- End Product Contracting, add covered UAS stipulation language
- Future Flight Service Contracting through the DOI Office of Aviation Services



USGS National Uncrewed Systems Office



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