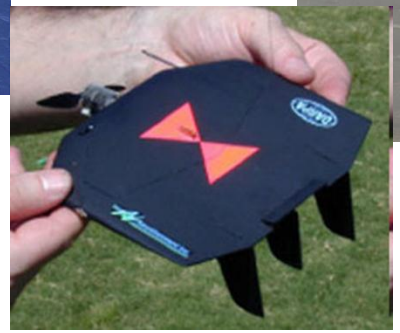
UAS Remote Sensing Platforms for Emergency Response and Management

Vince Ambrosia (CSU-Monterey Bay / NASA-ARC)

5th Technology Workshop for Oil Spill Response in the Marine Environment
26-28 February 2013
Sponsors: CA Dept, of Fish and Wildlife – OSPR and Chevron
Chevron Bishop Ranch 1-X
San Ramon, CA

Topics Addressed

- Introduction to UAS
- Current UAS Use Considerations / Regulations
- UAS Platform Decisions: Tactical vs. Strategic
- UAS Missions Supporting Disaster Monitoring
- FAA Modernization and Reform Act of 2012



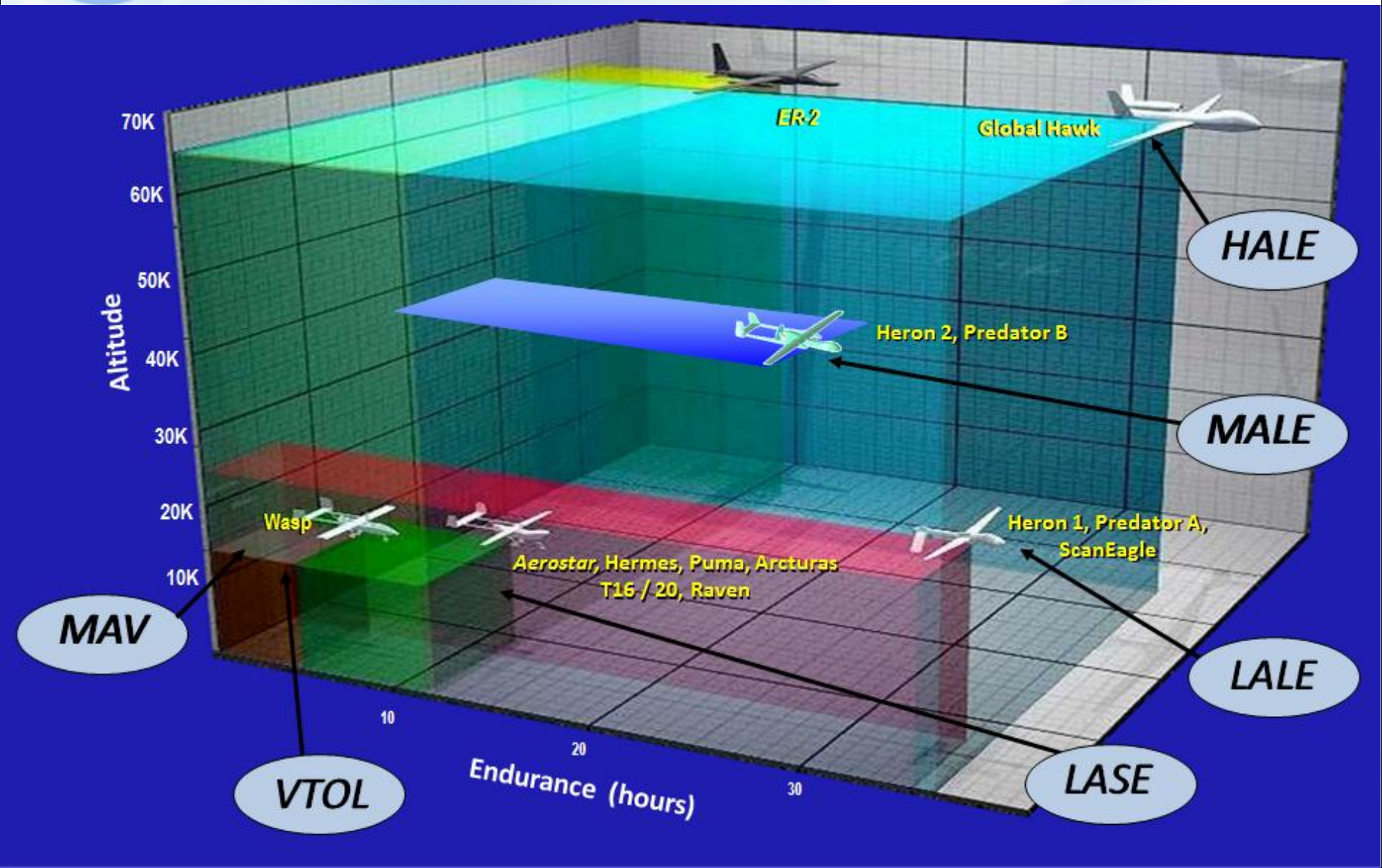
What is an UAS?

- Unmanned Aircraft: A device used or intended to be used for flight in the air that has no onboard pilot;

- A "SYSTEM" Includes:
  - Unmanned Aircraft (UA)
  - Aircraft Control Station
  - Command & Control Link/s

- Model Remote Control (hobby only)

UAS Nomenclature Designations



Who's Flying UAS

Public Use Aircraft

Department of Agriculture

Department of Commerce

Department of Defense

Department of Energy

Department of Homeland Security

Department of Interior

Department of Justice

NASA

NOAA

State Universities

State Law Enforcement

Civil Aircraft – Special Airworthiness Certificates – Experimental

AAI Corporation

General Atomics

Northrup-Grumman

AeroVironment…

Others

What Are They Doing?

- Operational Military Missions
- Research: scientific and academic
- Sensor Development and Testing
- Border Patrol
- Firefighting
- Disaster Relief
- Law Enforcement
- Search and Rescue

- Note: no commercial operations currently authorized

Regulations

Regulations: Public vs Civil Aircraft

- All aircraft must comply with FAA Code of Federal Regulations (CFRs)
- Civil aircraft (airlines, general aviation):
  - Required to obtain airworthiness certification from FAA
    - Compliance with FAA standards for manufacture, maintenance, etc
- Public Aircraft (government owned)
  - By law, are not required to comply with FAA airworthiness standards, but….
  - Must have airworthiness certificate to fly in NAS
    - In-house airworthiness process

NOAA Manta

Regulations: 14 CFR 91

- **Title 14, "Aeronautics and Space", Part 91 "General Operating and Flight Rules"**
  - **General, visual, and instrument flight rules (VFR, IFR)**
  - **Equipage, instrument, and certificate requirements**
  - **Required maintenance**
- **Created with manned aircraft in mind**

"UAS do not or cannot comply to a significant portion of 14 CFR 91 at this time"

Aerosonde (NSF, CU)

Current Methods of Access

- **Certificate of Authorization (COA)**
  - Method available to Public Aircraft only
    - Federal and State government including universities
    - Provide their own airworthiness statement
  - Approval given case by case
  - Provides access to specific areas with limitations and requirements
  - Expires 2 years after approval date unless otherwise noted
  - Takes 3 months for approval
- **Experimental Certificates for UAS**
  - Available to commercial companies for testing aircraft
  - Rigorous airworthiness review by FAA
  - Certificate grants access to specific areas with tight restrictions for operations

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UAS Platform Decisions

UAS Platform Decisions

Tactical

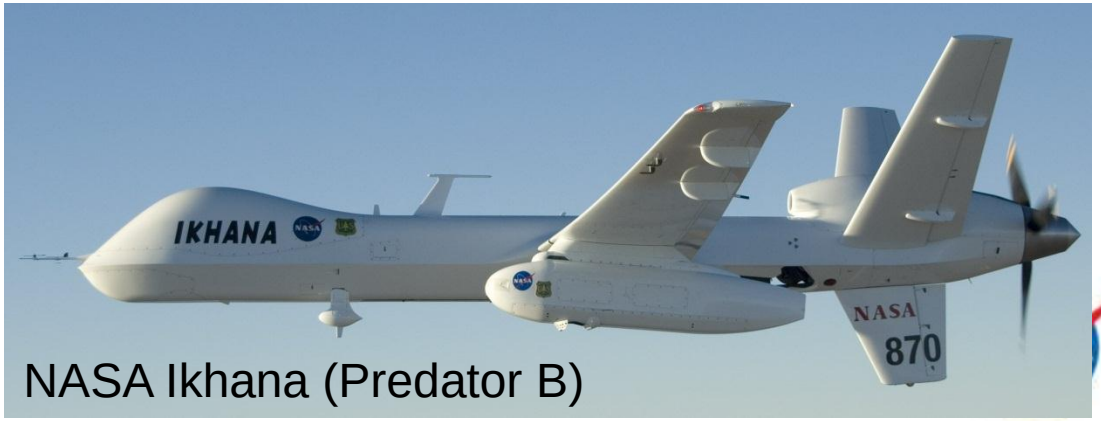
LASE / LALE, small-area coverage
(over-the-hill assessments)

USGS Raven

UAF ScanEagle

Strategic

MALE / HALE, large-area coverage,
long-duration coverage



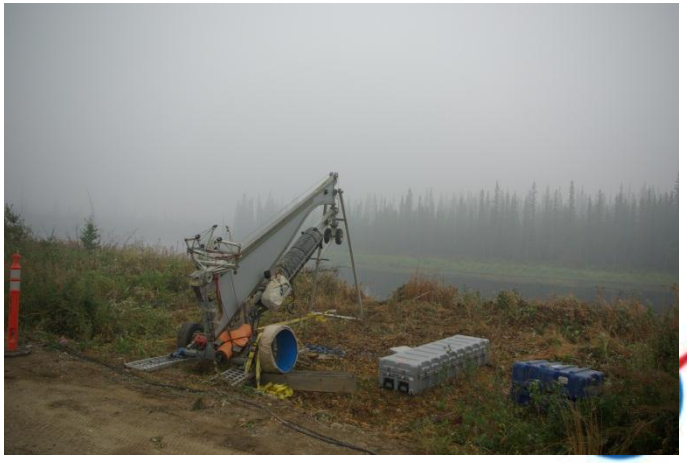
NASA Ikhana (Predator B)

UAS Platform Decisions

Tactical

The situations where tactical UAS (sUAS) can support disaster observations:

- Incident crews use to provide real-time photo / video and IR imagery in tactical situations;
- Direct support to incident operations;
- Conditions where manned aircraft cannot operate (smoke, night, difficult terrain, etc.);
- Support by sUAS is required immediately / ability to launch quickly



Sensor Capabilities

Small UAS < 55 pounds:

- Full Motion Video
- Small Format Frame Camera
- Thermal- Infrared
- Chemical- Gas Plume Detection
- Meteorological- temperature
- Radio Telemetry

Larger UAS Platforms:

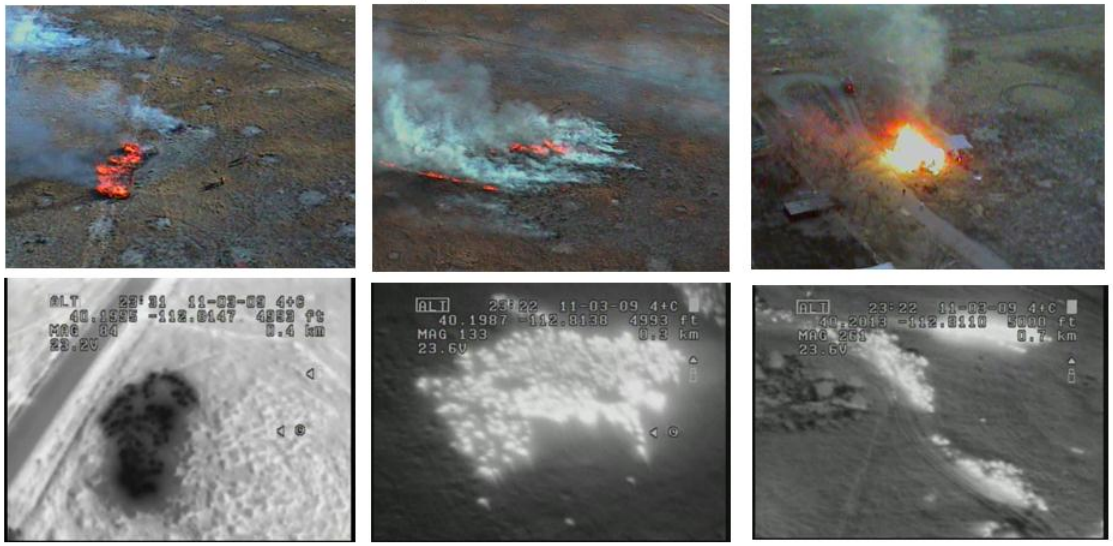
- Electromagnetic
- Laser Range Finder
- LiDAR
- Hyperspectral
- Radars (SAR)
- Traditional Mapping Camera
- True Multispectral

sUAS: Fire Imaging

Small (tactical) UAS typical data captures and systems:

TASE 150 image of fire on George Washington Jefferson NF, VA, 2011 (courtesy of D. Yoel, AAAI)

Electro-Optical Video of Prescribed Burn



Infrared Video of Prescribed Burn

UAS Platform Decisions

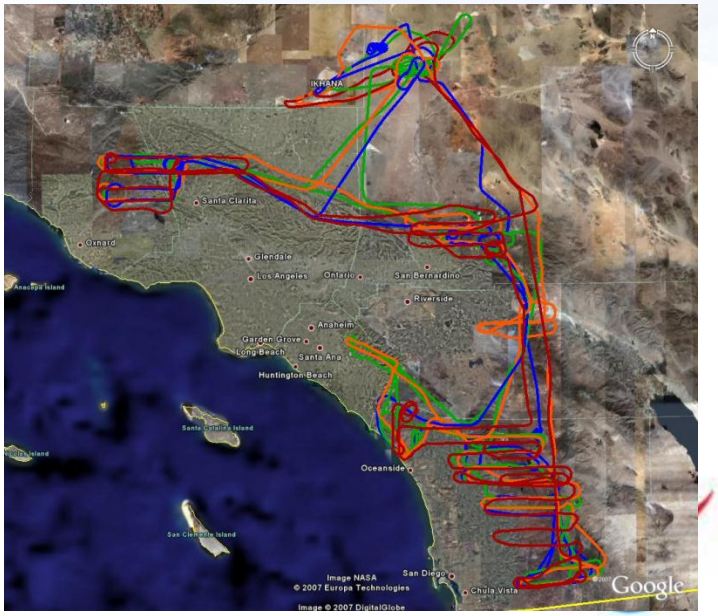
Strategic

The situations where strategic UAS can support disasters (wildfire) observations:

- Long-endurance data collection flights over remote fire areas, covering a large number of incidents;
- Provide communications link (radio repeater) between Incident Command (IC) and ground resources);
- Provide R/T day / night sensor imagery of fire behavior to IC;
- Ability to fly above, and out of way of all other fire aviation aircraft (out of TFR or FTA).

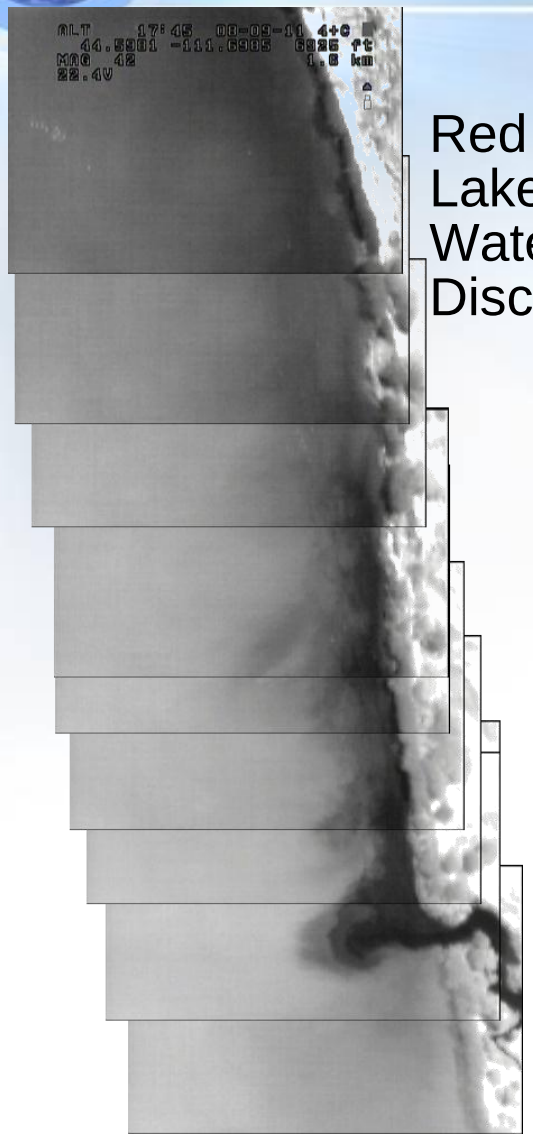
NASA Ikhana UAS

NASA Ikhana missions: 10/2007



UAS Supporting Disasters / Enviro Studies

USGS Efforts



Red Rock Lakes MT. Water Thermal Discharge

Missouri River Erosion, South Dakota

USGS Raven UAS IR Video Capture

USGS Raven IR video natural color

DHS UAS Operating Locations

GRAY BUTTE, CA
Flight Test Center

GRAND FORKS, ND
Flight Operations Center

FORT DRUM, NY
Forward Operating Location

WASHINGTON, DC
Air & Marine Headquarters

RIVERSIDE, CA
Air Operations Center

OKLAHOMA CITY, OK
National Air Training Center

SIERRA VISTA, AZ
Flight Operations Center

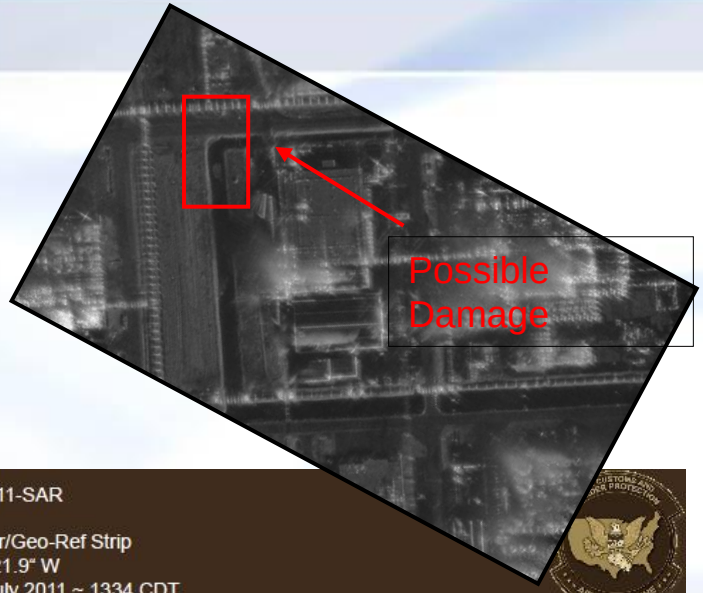
CORPUS CHRISTI, TX
Operations Center
September 2010 Deployment

FLORIDA:
Maritime Operations Center
2010 Stand Up

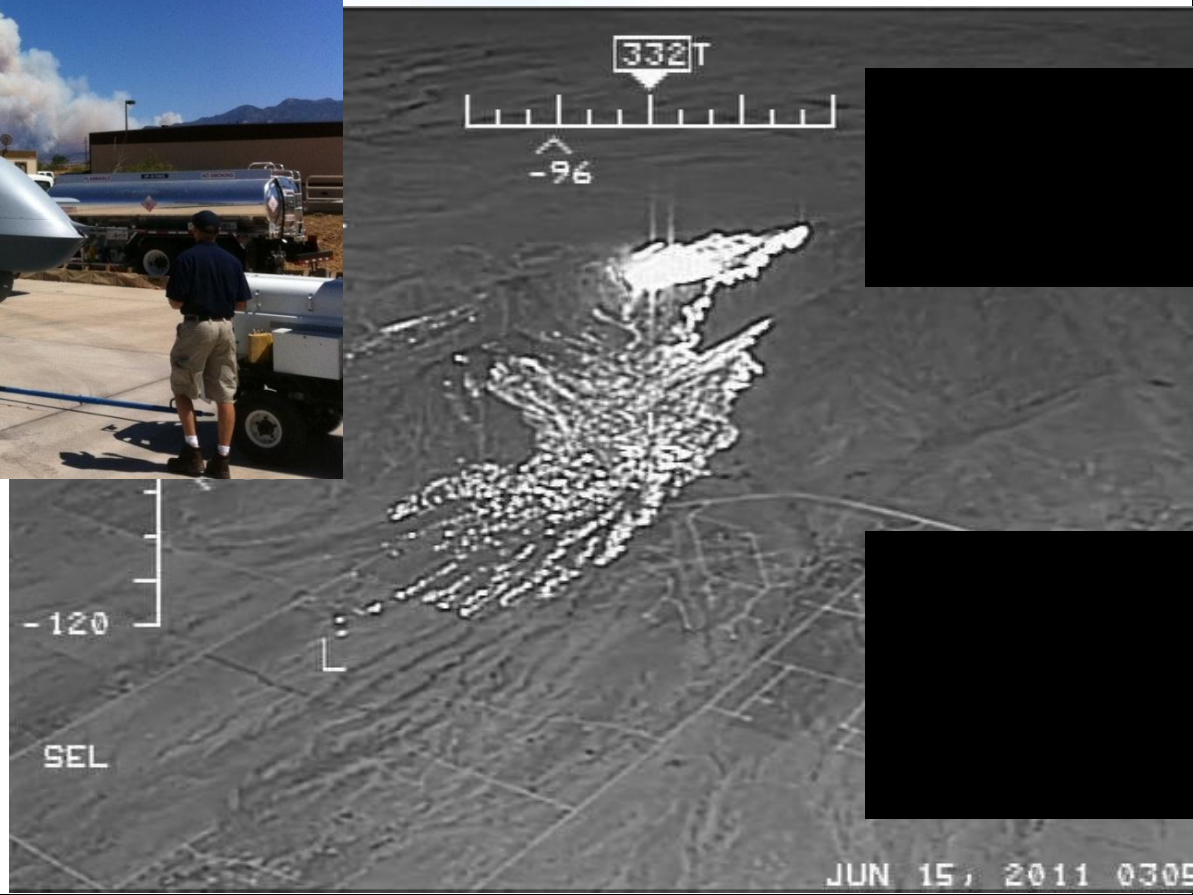
NORTHERN REGION
SOUTHWEST REGION
SOUTHEAST REGION

UAS Natural Disaster Support

- Hurricane Gustav 2008
- Hurricane Hanna 2008
- Hurricane Ike 2008
- Red River Flooding, multiple years (CBP)
- Missouri River Levee / Flooding (CBP)
- AZ Wildfires, 2011 (CBP)



Monument Fire; 14 June 2011



AAAI UAS Performance

UA Type	RS-16™	RS-20™
Wingspan	12' 11"	17' 3"
MGTW	85 lbs	165 lbs
Endurance	12-16 hrs	6 hrs (12-16 hrs future)
Ceiling	15,000'	15,000'
Max Speed	65 kts	75 kts
Payload Envelope	6 x 6 x 20.5"	10.75 x 10.75 x 34"
Payload Capacity	25 lbs	65 lbs
Payload Power (continuous)	100 watts	400 watts
Launch	Pneumatic Catapult	
Recovery	Belly Land	
Hard Points	0	2@20 lbs ea

The most advanced, commercial, long endurance UAS fleet in the United States

RS-16 UAS Missions & Benefits

- Inspection & Surveillance
  - ROW Monitoring
- Emergency Management
  - Oil Spills
  - Fires
  - Hurricanes
  - Tornados
  - Floods
  - Search and Rescue
- Airborne Science
- Flight Test

- Simultaneous Payload Operations
  - Machinery Threat + Oil + Methane(?), and
  - Precision Weather, and
  - Ad Hoc Mobile Communications
    - Voice, data & networking
- Far greater endurance
- Ideal for “Dull, Dirty and Dangerous” missions
  - Without putting pilots in harms way
- Higher precision flight profiles
- Smaller signature
- Cost competitive in routine operations
  - Overseas: Now
  - In United States: 2 to 4 years (in rural areas)

Upcoming RS-16 UAS Campaigns

- 450 square mile FAA flight authorization including areas of the Gulf of Mexico
- Oil Spill Remote Sensing Payload - 1st flight on UAS

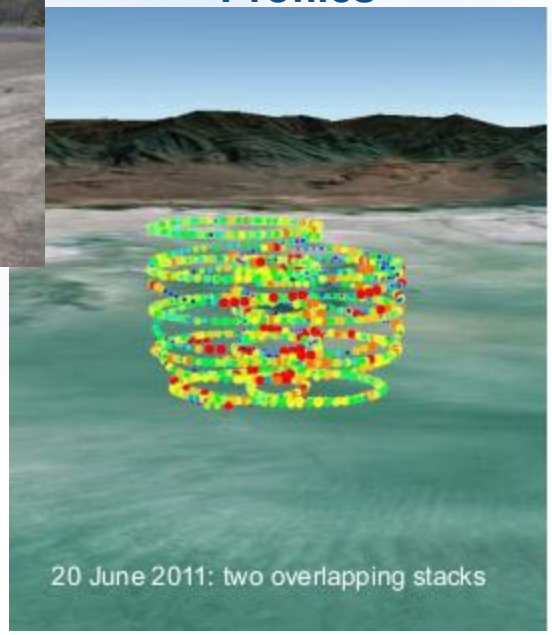
- South Texas
  - Week of March 11th
  - Flying oil spill sensor
  - Can host a few observers
- Natural Gas Pipeline Test
  - Proposed in April May
- Long-Range UAS Demo under COA
  - Proposed on transmission corridor with both oil & gas lines

NASA SIERRA UAS CO2 / Methane Observations

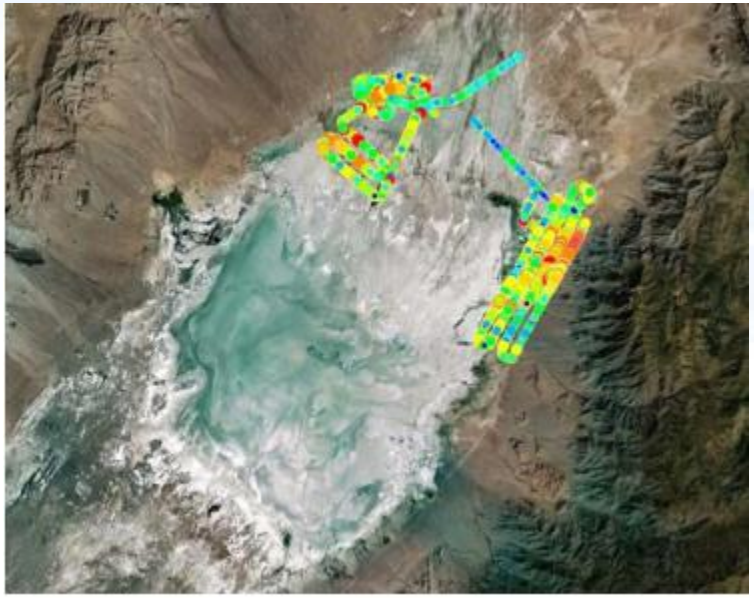
Railroad Valley, NV

SIERRA UAS Prepared for Launch

Flight Tracks and CO2 Profiles



Flight Tracks and Methane Profiles



On-board Picarro Inc. Gas Analyzer showed extensive pockets of methane seeping into air in the Railroad Valley area , attracted attention of PG&E who purchased 100 of the analyzers for field monitoring of methane leaks.

FAA Modernization and Reform Act of 2012:

Expedited access for UAS public aircraft

- Setting a 30 Sept 2015 deadline for full integration of UAS into the NAS;
- Requiring a comprehensive integration plan within nine months;
- Requiring the FAA to create a annual UAS roadmap;
- Requiring sUAS (under 55 pounds) to be allowed to fly within 27 months;
- Requiring six UAS test sites to be established within six months;
- sUAS (under 55 pounds) be allowed to fly in the U.S. Arctic, 24 hours a day, beyond line-of-sight, at an altitude of at least 2,000 feet, within one year;
- Requiring expedited access for public users, (government) such as law enforcement, firefighters, emergency responders;
- Allowing public users to fly very small UAS (4.4 pounds or less) within 90 days- LOS, below 400 ft., daylight, outside 5 miles from airport or other aviation activities;
- Requiring the FAA to study UAS human-factors and causes of accidents.

More Resource Information

- Association of Unmanned Vehicle Systems International (AUVSI) has an excellent (Jan 2013) position paper pdf/ ppt entitled:

  "*Privacy and Legal Issues Associated with UAS Operations*"

by Ben Gielow, Govt. Relations Manager & AUVSI General Council; gielow@auvsi.org or www.auvsi.org

- POC for DHS CBP Predator UAS Support to National Needs / Emergencies / Disasters (coastal environs, spills, fires, flooding):
  - John W. Priddy; DHS-CBP; john.w.priddy@cbp.dhs.gov

- USGS UAS National Project Office; Mike Hutt; Denver, CO; mehutt@usgs.gov; 303-202-4296

- American Aerospace Advisors, Inc. (AAAI), Airborne Systems Group; Dave Yoel; www.American-Aerospace.net; 484-995-0709

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