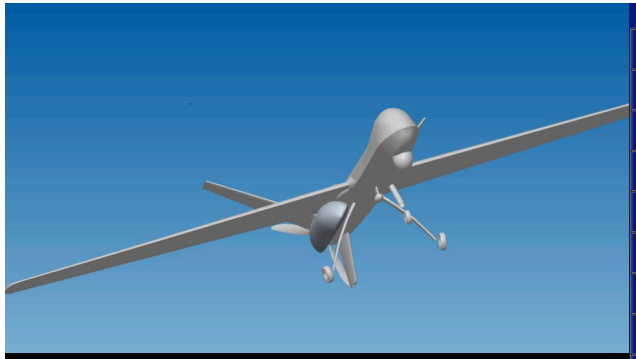
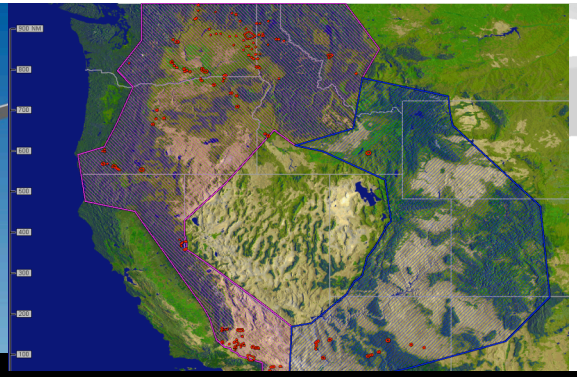
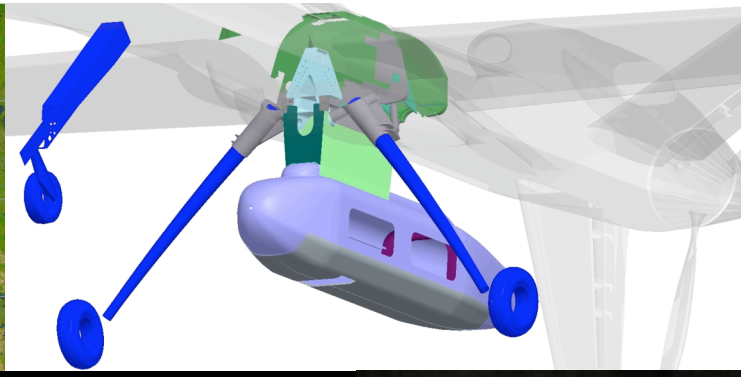






Earth Science Capability Demonstration Project

Brent Cobleigh
Ikhana Project Manager
5/10/06

ESCD Project

UAV Capability Assessment Needs

NASA Earth Science Mission Requirements

External Customer Requirements

Technology Demonstrations

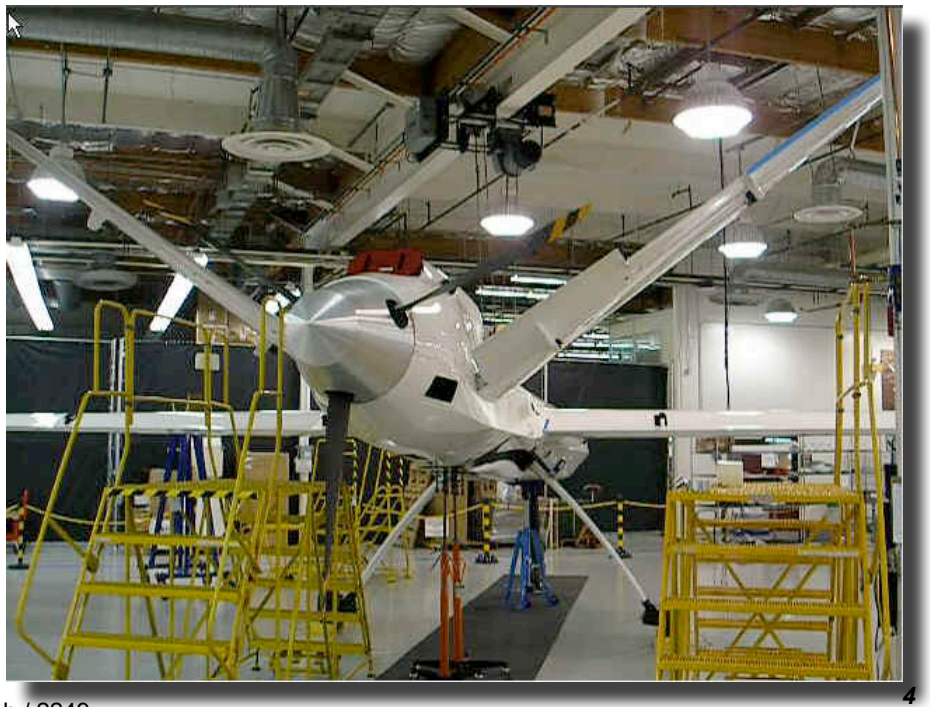
Mission Demonstrations

Available Flight Assets

- **Ikhana (Predator-B)**
  - Delivery in June 2006
- **Altair**
  - First triple redundant Predator-B
  - Long term lease, 300 day/year
  - Manufacturer operated
- **APV-3**
  - Mini-UAV
  - Research flight control development & pilot vehicle interface/displays
- **G-III**
  - DFRC owned
  - UAV surrogate for sensor demonstration

Ikhana Procurement

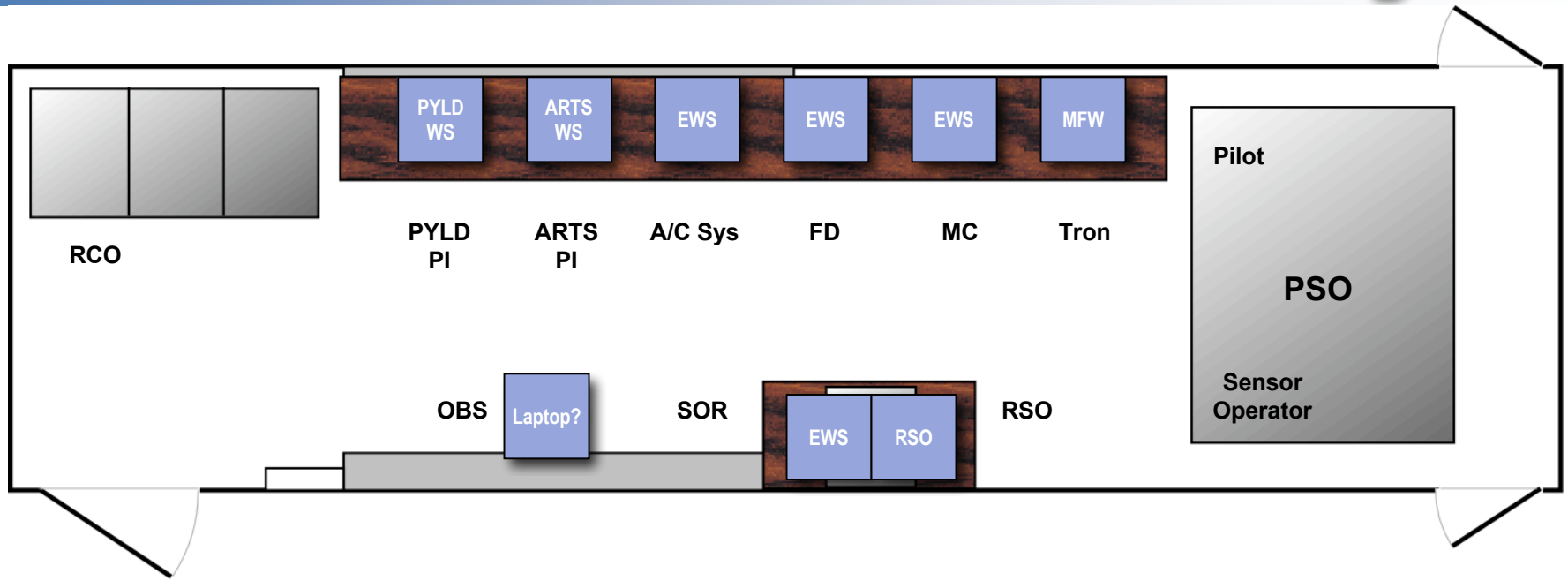
- **Predator-B Hunter Killer**
  - 1st Digital Electronic Engine Control
  - Ku Satcom system
  - Contract Delivery June 20, 2006 (on schedule)
- **Aircraft recently moved to Gray Butte for ground and flight test**



GCS Layout

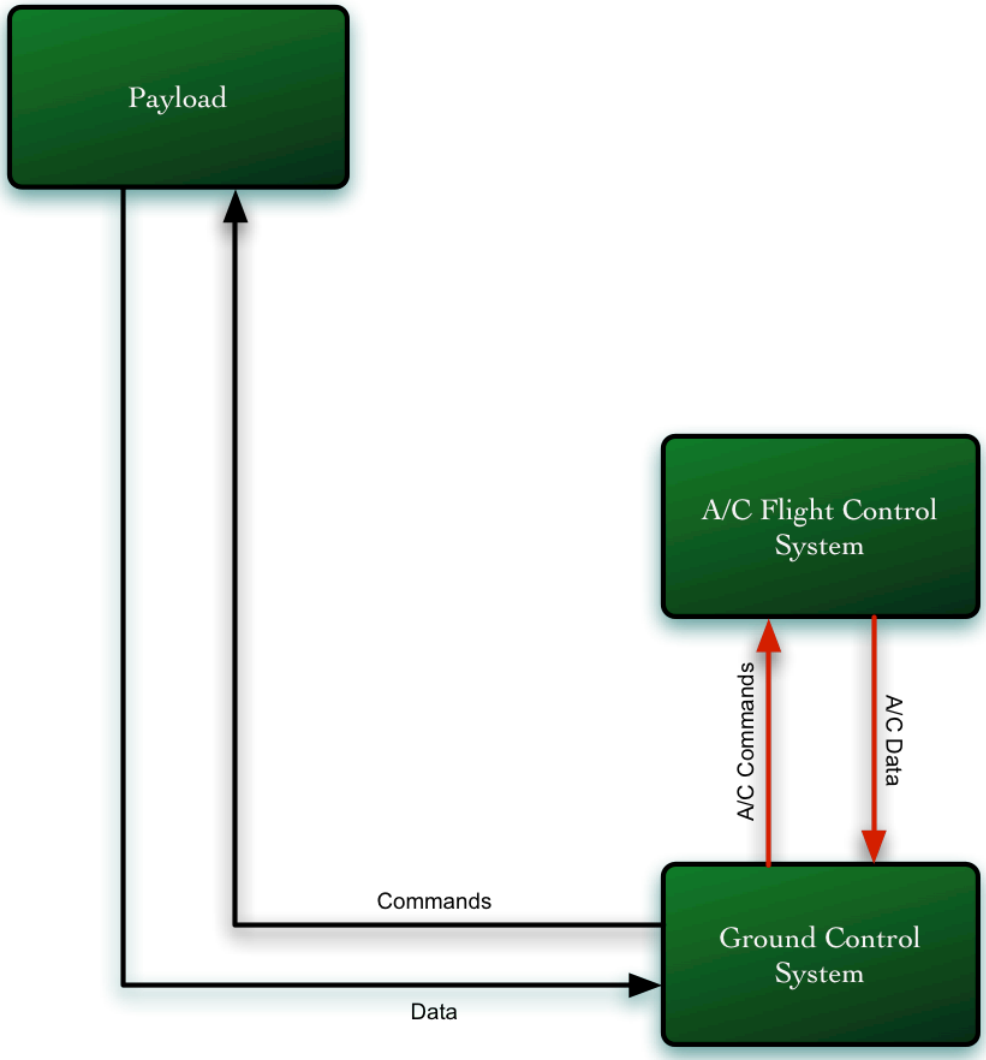
- **Mobile Ground Control Station**
  - Standard General Atomics Pilot & Sensor Operator Ground Control Station
  - C-130, C-17 Compatible
  - Mobile C-band & 4.5m SatCom antenna
  - Delivery late Summer 2006

GCS Layout

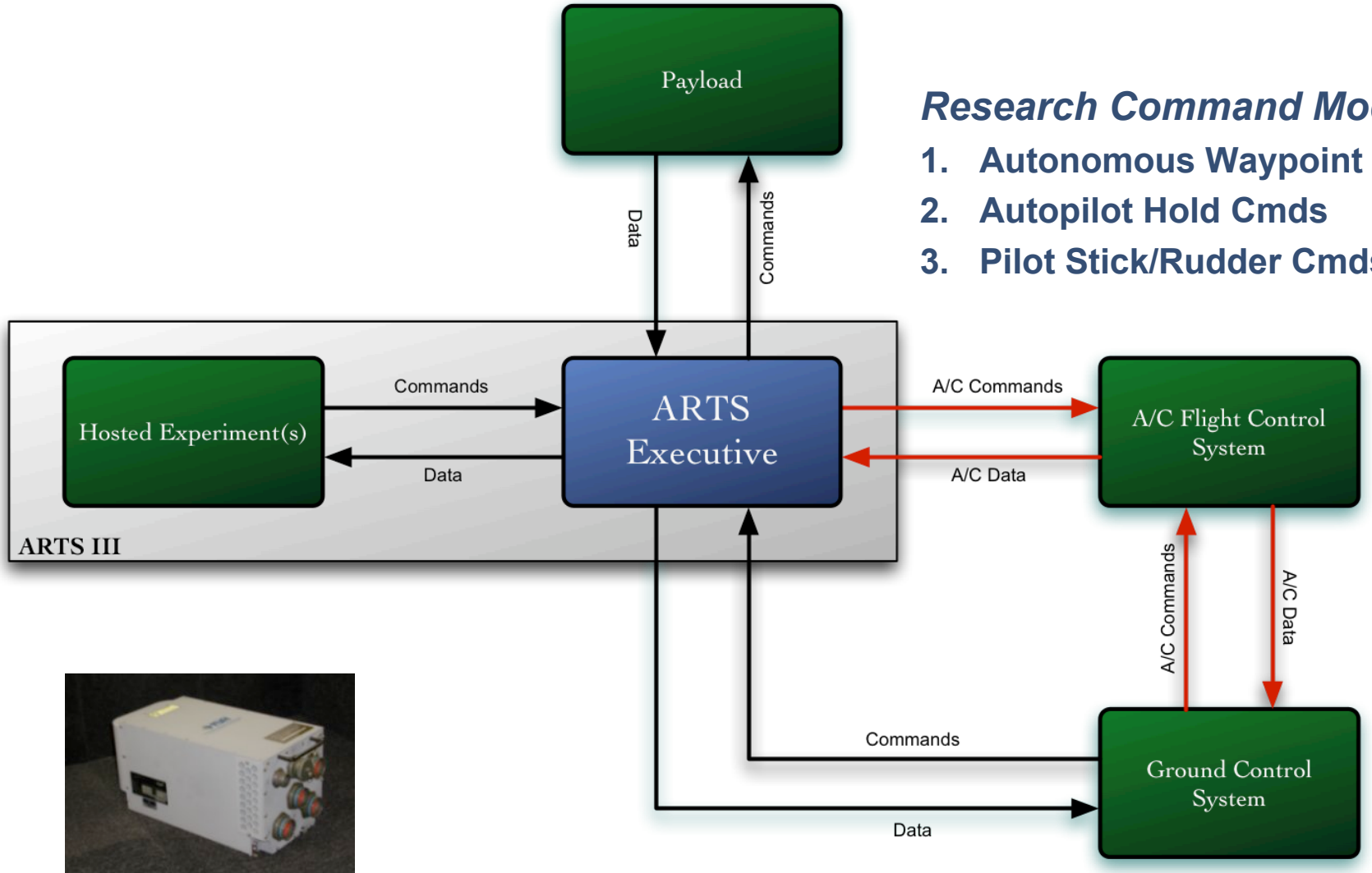


- 6 custom engineering monitoring stations
- Able to monitor & command aircraft and experiments
- Networked to WWW
- Access to aircraft and ground video
- Range Safety/Flight Termination

Baseline Predator B Architecture



Ikhana Architecture



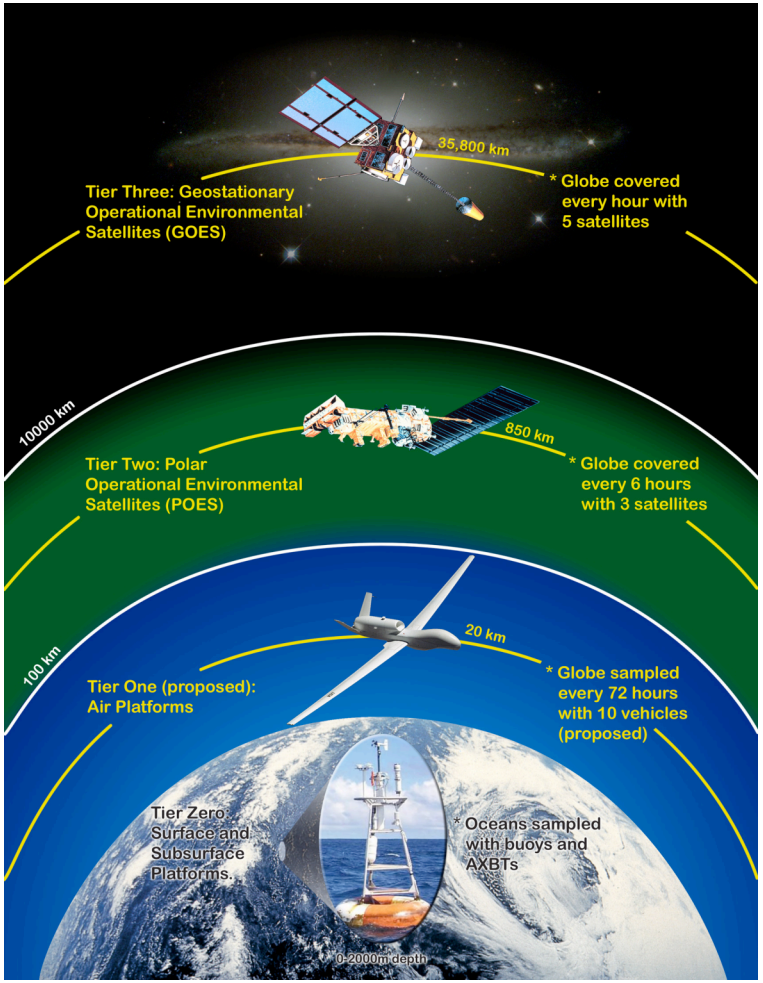
Research Command Modes

1. **Autonomous Waypoint Cmds**
2. **Autopilot Hold Cmds**
3. **Pilot Stick/Rudder Cmds**

ARTS II

UAV Capability Assessment

- **In depth assessment of UAV capabilities required for Earth Science, Civil, and Homeland Security**
  - Complement to DOD UAV Roadmap
  - Influence the management of the UAV technology portfolio based on user defined future needs
- **6 workshops completed**
  - Sub-Orbital Science Missions of the Future
  - Global Climate Change (2): NASA/NOAA/DOE
  - Science Sensors and Power / Propulsion
  - Homeland Security
  - Land Management and Coastal Zone Dynamics
- **Product is a living document that identifies and tracks relevant technology gaps**
  - Updated annually
  - Vetted with participating agencies



Website: http://www.nasa.gov/centers/dryden/research/civuav/index.html

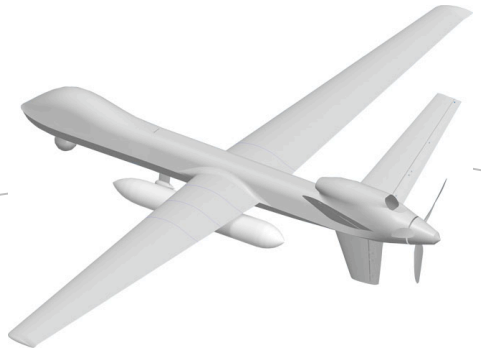
The Big Picture

Access to National Airspace
Remote Command and Control
Long Range and Endurance
Increased Platform Availability
Quick Deployment
Terrain Avoidance
Formation Flight
Precision Trajectory
Multi-Ship Control
Precision State Data
High Altitude
All Weather
Vertical Profiling
Deploy/Retrieve
Covert Operation

Autonomous Mission Management
Intelligent System Management
Collision Avoidance
Reliable Flight Systems
Sophisticated Contingency Management
Intelligent Data Handling/Processing
Over-the-Horizon Comm
Power and Propulsion
Enhanced Structures
Open Architectures
Precision Navigation

New Capabilities

New Technologies



New Missions

Earth Science
River Discharge
Forecast Initialization
Stratospheric Ozone Chemistry
Magnetic Fields Measurements
Glacier and Ice Sheet Dynamics
Cloud and Aerosol Measurements
Tropospheric Pollution and Air Quality
Focused Observations – Extreme Weather
Gravitational Acceleration Measurements
Hurricane Genesis, Evolution, and Landfall
Ice Sheet Thickness and Surface Deformation
Repeat Pass Interferometry for Surface Deformation
Topographic Mapping and Topographic Change with LIDAR

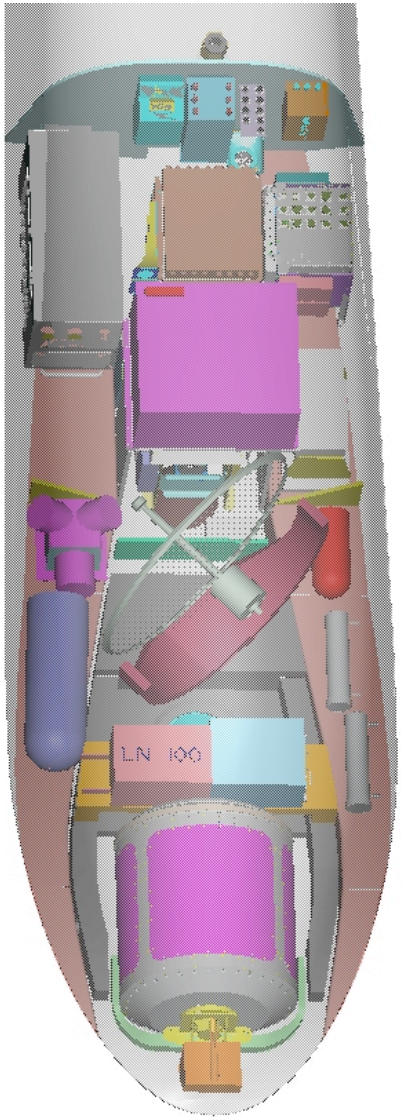
Land Management
Precision Agriculture
Wildfire/Disaster Response
Water Reservoir Management
Wildlife Management Population Count
Identification and Tracking of Maritime Species

Homeland Security
Coastal Patrol
Broad Area Surveillance
Border Patrol Situational Awareness
Marine Interdiction, Monitoring, Detection, Tracking

Source: Civil UAV Capability Assessment, ver 1 update 2

Mission Demonstrations

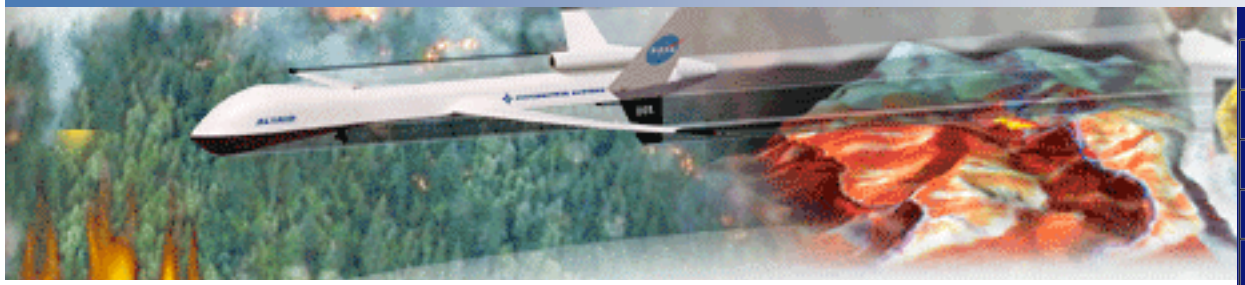
NASA/NOAA UAV Demo (5/05 to 9/05)

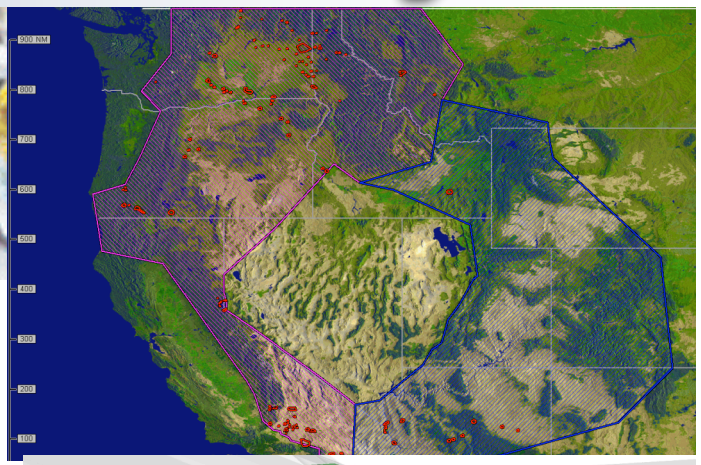


- **5 Missions using Altair**
  - Up to 18.6 hrs
- **Sensors**
  - Ocean Color Sensor/Passive Microwave Vertical Sounder
  - Gas Chromatograph/Ozone Instrument
  - Cirrus Digital Camera System
  - REVEAL
  - EO/IR Skyball
- **Objectives**
  - Atmospheric river sampling
  - Marine sanctuary surveillance/enforcement
  - Channel Island mapping
  - Ocean color profile
- **Objectives achieved**

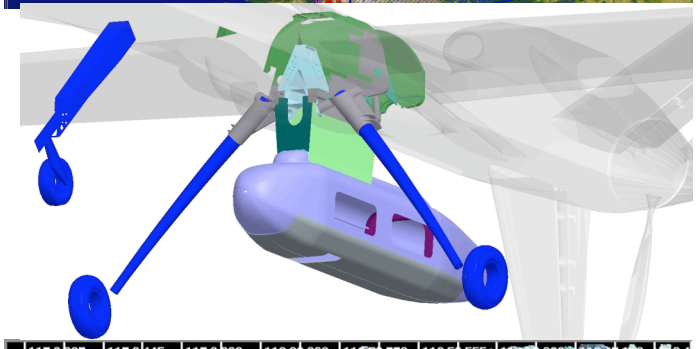
B. Cobleigh / 2249

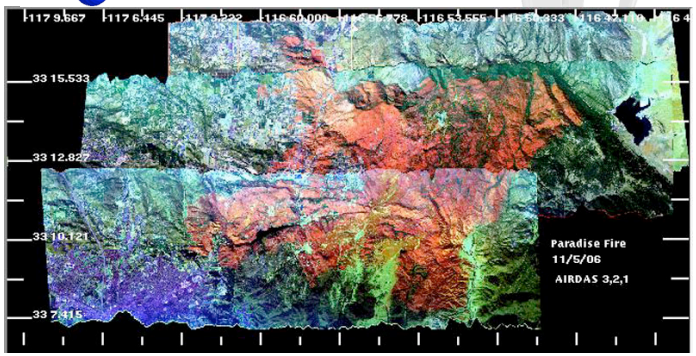
NASA/USFS Western States Fire Mission (8/06)





- Multi-spectral camera to locate and map known and unknown fires in National Forest (August/September 2006)
- Thermo geo-rectified imagery provided to the National Interagency Fire Center in near real-time
- Sensors pod-mounted for quicker aircraft reconfiguration
- Aircraft will be tasked in similar fashion to other USFS assets
  - Can operate day and night
- Will be ready to respond from So. California to Montana
- Long duration (~20 hours) over-land operation in the NAS will provide challenges





Technology Development

Suborbital Telepresence

- **Development of technologies and standards for low-cost airborne sensor webs**
- **System allows for on-board sensor**
  - Processing and storage
  - Remote monitoring
  - Remote control
- **Demonstrations completed on ER-2, Altair, DC-8**
  - 12-channel Iridium for low-cost, global coverage
  - Data ported to internet in near real-time
  - Dynamically reconfigurable to multiple aircraft, satellite, ground source communication
- **Airborne Sensor Web standards in-work**