Earth Science Capability Demonstration Project

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ESCD Project

UAV Capability Assessment Needs

NASA Earth Science Mission Requirements

External Customer Requirements

Technology Demonstrations

Mission Demonstrations

NASA Earth Science Mission Requirements

External Customer Requirements

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
• 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

Payload

A/C Flight Control System

Ground Control System

Commands

Data

A/C Commands

A/C Data
Research Command Modes
1. Autonomous Waypoint Cmds
2. Autopilot Hold Cmds
3. Pilot Stick/Rudder Cmds
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

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

New Capabilities
- 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

New Technologies
- 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 Missions

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**
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