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
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
- 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
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

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
- 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
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