Suborbital Science Program

Dryden Flight Research Center

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Program Objectives:
Satellite Calibration and Validation

Provide methods to perform the cal/val requirements for Earth Observing System satellites

New Sensor Development

Provide methods to reduce risk for new sensor concepts and algorithm development prior to committing sensors to operations

Process Studies

Facilitate the acquisition of high spatial/temporal resolution focused measurements that are required to understand small atmospheric and surface structures which generate powerful Earth system effects

Airborne Networking

Develop disruption-tolerant networking to enable integrated multiple scale measurements of critical environmental features
Dryden supports the NASA Airborne Science Program and the nation in the following elements:

**ER-2**
Provide this unique, high altitude research platform to the research community

**Ikhana (Predator B) & Global Hawk**
Provide access to developmental UAS capability

**REVEAL**
Disruption-tolerant airborne networking over-the-horizon

**G-3**
Provide a flexible, mid-range platform to the science community

**DC-8**
Flying laboratory, provide heavy lift platform and multiple instrument capability
ER-2

Capabilities
- Endurance > 10 hours
- Ceiling > 70,000 ft
- Payload 2,600 lbs
- Range > 4,000 nautical miles

Mission Support Features
- Multiple locations for payload instruments
- Pressurized and un-pressurized compartments
- Standardized cockpit control panel for activation and control of payload instruments.
- Iridium communications system
- World-wide deployment experience

Background and Status
- U-2 and ER-2 aircraft have been a mainstay of NASA airborne sciences since 1971
- Over 100 science instruments integrated
- Continuous capability improvements
- Two aircraft currently available for:
  - Remote sensing
  - Satellite calibration/validation
  - In-situ measurements and atmospheric sampling
  - Instrument demonstration, test and evaluation
Ikhana (Predator B)

**Capabilities**
- Endurance: 30 hours
- Ceiling altitude > 40,000 ft
- Payload > 2,000 lbs (750 in pod)
- Range: 3,500 nautical miles
- Standard MQ-9 w/digital engine control

**Mission Support Features**
- Airborne Research Test System
  - enables effective flight control research
- Mobile ground control station
  - supports campaign deployment
- External experimenter pod
  - rapid/flexible experiment integration

**Status**
- ‘Mission Ready’ date - June, 2007
  - A/C delivered in Nov. 2007
  - NASA pilots and crew
  - NASA unique systems in progress
- Science Campaigns:
  - Western States Fire Mission 2007
- Cost- sharing with non-SMD projects
  - Fiber Optic Wing Sensor
Global Hawk

Capabilities
Endurance > 30 hours
Range > 11,000 nmi
Altitude 65,000 ft
Payload > 1,500 lbs
DC Power 2.0 KW
AC Power 8.3 KVA

Mission Support Features
- Multiple payload locations.
  - Pressurized and un-pressurized.
  - Can accommodate wing pods (future).
- REVEAL system with ethernet network on the aircraft for payload C2/status.
- Fully autonomous control system, take-off to landing.
- Redundant LOS and BLOS aircraft command and control comm links.
- Redundant BLOS ATC comm links.
- Available by Summer, 2009
Objectives

- Develop/demonstrate low-cost services for science payloads
  - Situational awareness
  - Decision support; productivity
  - Sensor web: *i.e.* Instrument interaction/C4I
- Applicable to all suborbital platforms, but special significance for UAS applications
**Mission Objective**
- Provide new capability for solid earth science
  - Airborne repeat-pass radar imaging
  - Interferometric mapping of deforming surfaces

**Description**
- Synthetic aperture radar
- Pod mounted instrument
- < 10 m tube flight path using JPL real-time DGPS and Dryden Platform Precision Autopilot
- Compatible with Gulfstream G-3 or UAS
- Ready for other applications
DC-8

Capabilities
- Ceiling 42,000 ft.
- Duration 12 hours
- Range > 5,400 nautical miles
- Payload 30,000 lbs
- 4 CFM56-hi-bypass turbofan engines

Mission Support Features
- Shirt sleeve environment for up to 30 scientist/investigators
- Worldwide deployment experience
- Extensive modifications to support in-situ and remote sensing instruments, including zenith and nadir viewports, wing pylons, modified power systems, 19 inch rack mounting, extensive on-board data acquisition system, and on-board experiment network

Background and Status
- Acquired by NASA in 1986
- Long history of supporting studies in archaeology, astronomy, ecology, geology, hydrology, meteorology, oceanography, volcanology, atmospheric chemistry, soil science and biology
Airborne Science - Summary

Dryden Capabilities include:

- Aeronautics history of aircraft developments and milestones
- Extensive history and experience in instrument integration
- Extensive history and experience in aircraft modifications
- Strong background in international deployments
- Long history of reliable and dependable execution of projects
- Varied aircraft types providing different capabilities, performance and duration

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