# Airborne Science Annual Review

**NASA Headquarters**
**February 6, 2008**

# Dryden Flight Research Center

**Bob Curry**

# ER-2
## Core Aircraft for Very High Altitude

*Capabilities*

- Ceiling > 70,000 ft
- Duration > 10 hours
- Range > 4,000 nautical miles
- Payload 2,600 lbs
  (700 lbs in each wing pod)

*Mission Support Features*

- Multiple locations for payload instruments
- Pressurized and un-pressurized compartments
- Standardized cockpit control panel for activation and control of payload instruments
- 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
- Two aircraft

# ER-2, cont

TC-4 Science/Aircraft Team On-Station in Costa Rica

***2007 Activity* (231 Hours)**

- **NASA science missions**
  - **TC-4 (Costa Rica)**
  - **Local AVIRIS and MAS**
  - **Large Area Collectors**
- **DOE CLASIC (Ellington Field)**
- **Non-science users**
  - **DHS**
  - **MDA**

***Outlook***

- **Seeking to reduce operational costs to SMD**
  - **Project re-structuring , greater workforce sharing**
  - **Continued interest from non-Science government agencies**
- **Re-location to the Dryden Aircraft Operations Facility in Palmdale in Summer**

# DC-8

## Core Aircraft for Medium Altitude, Heavy Lift

*Capabilities*

- Ceiling 42,000 ft.
- Duration 12 hours
- Range > 5,400 nautical miles
- Payload 30,000 lbs

*Mission Support Features*

- Shirtsleeve environment for up to 30 scientist/investigators
- worldwide deployment experience
- Extensive modifications to support in-situ and remote sensing instruments
  - zenith and nadir viewports
  - wing pylons
  - modified power systems
  - 19 inch rack mounting

***Background***

- **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**

# DC-8, cont.

*2007 Activity*

- TC-4 (Costa Rica)
- C-Check
- Extensive facility improvements


TC-4 Flight Preparations in Costa Rica

## *Aircraft and Facility Upgrades*

New 1-F Flight Management System
New Terrain Awareness Warning System to meet FAA requirements
New Digital Aircraft Flight Recorder to meet FAA requirements
New Navigation Units with FM Immunity to meet European Standards
New Digital COMM / NAV Control Panels
New IRIDIUM air/ground communications for Flight Crew
Wing tip probe upgrades

## *Data Acquisition and Display System Upgrades*

REVEAL data acquisition system
IRIDIUM based satcom system
X-chat capability with ground
New gigabit ethernet based data display system
Backward compatibility with RS-232 data stream
High resolution LCD displays
Dedicated Mission scientist station
Digital video system

# DC-8, cont.

*Aircraft operations transferred to Dryden in August*

- Aircraft re-located to Palmdale, CA
- University of North Dakota participation continuing through
  - Science management
  - Public outreach and education

Arrival at the Dryden Aircraft Operations Facility, Palmdale, CA

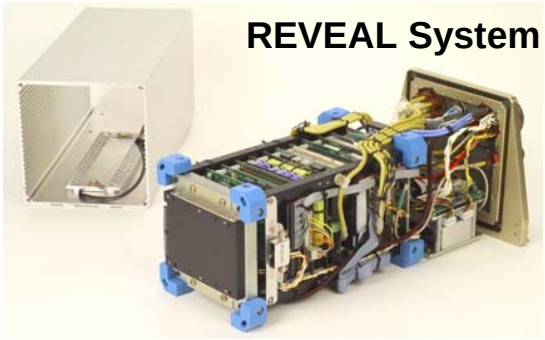
*Outlook, 2008 missions*

- ARCTAS
  - Spring – Alaska, Greenland
  - Summer – California, Canada, Greenland
- AMISA
  - August - Sweden

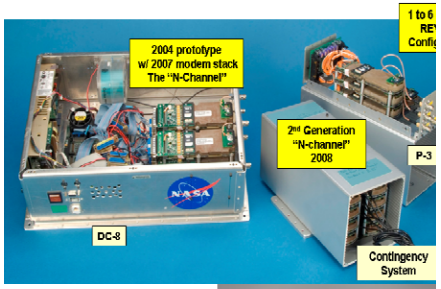
# Suborbital Tele-Presence (REVEAL)

## *Objective:*

**Provide situational awareness and instrument interaction for the science team during flight**




**REVEAL= Research Environment for Vehicle Embedded Analysis on Linux**




## *Goal:*

**Deliver V1.0 system architecture in 2010**

## *Approach:*

- **Phased development**

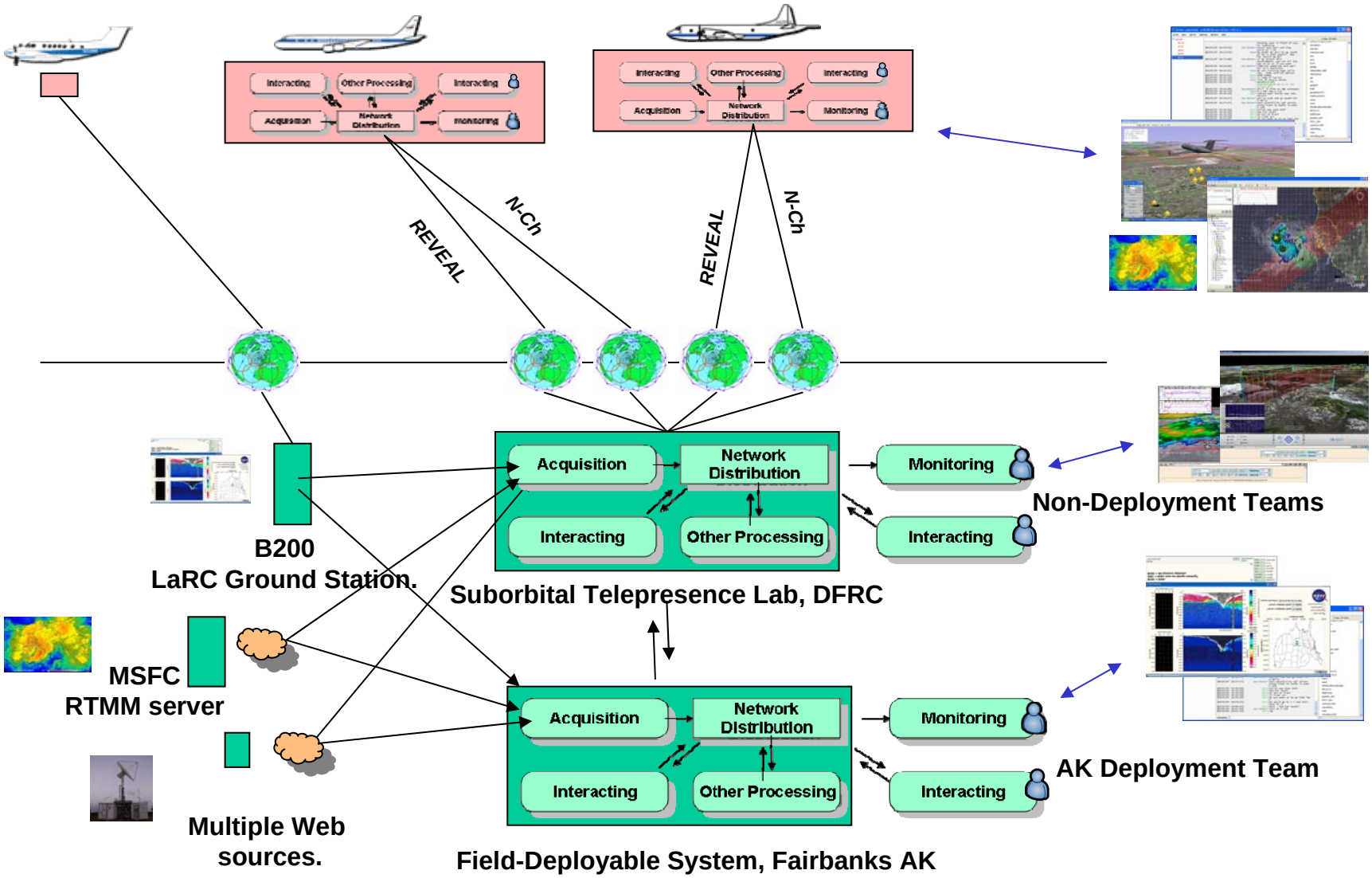
***2007 Activities***

REVEAL P-3
Field Deployable Ground Station
LINUX multi-link operations
DC-8 infrastructure upgrades

CLASIC / ER-2
TC-4 / WB-57, DC-8, ER-2
CARS / P-3

- **Apply incremental systems to high value science campaigns**

# ARCTAS Notional Implementation

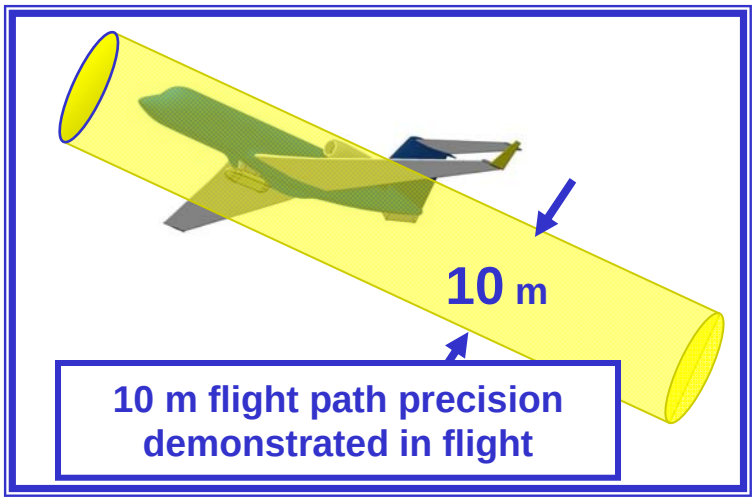


# G-III UAVSAR (JPL Partnership)

## Test-bed for UAS and Space Based Radar Technology

### *2007 Accomplishments*

- **Demonstration of precision autopilot**
- **Collection of first first images from a pod-mounted L-Band Synthetic Aperture RADAR**
- **Cruise envelope expansion (ventral fin removed)**


### *Capability Development Activity*

- **Ka Band pod development – in work**
- **Pylon reduction – design complete**
- **Lidar integration – study**
- **REVEAL – study**
- **Automated formation flight - study**

# G-III UAVSAR Mission Development

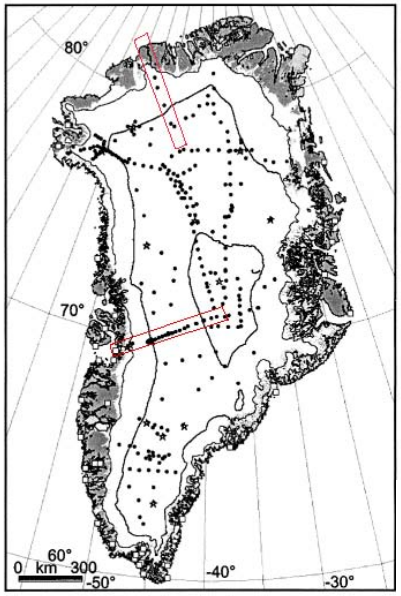
***IPY – Greenland***

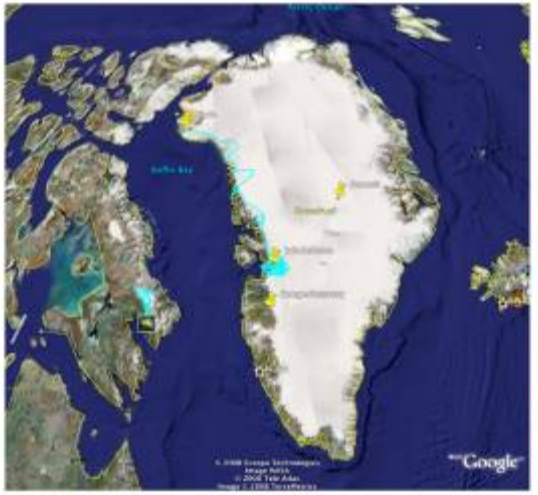
- **May, 2009**
- **Deployment to Thule**
- **L-Band and Ka-Band SAR, dual pods**
- **Coordinated flight with P-3**

***Other applications in study***

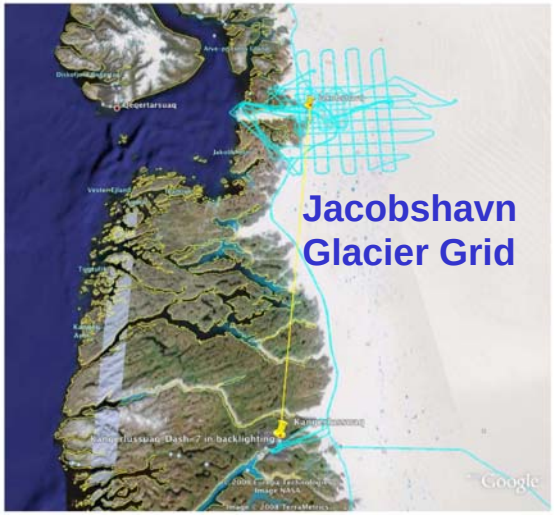
- **California fires**
- **Central America Archaeology**
- **Crustal Deformation**
- **Biomass/Forest Structure**
- **Decadal Survey Risk Reduction (Destiny, SCLP, . . .)**

L-Band Repeat Pass



Ka -Band Bi-Static (Single Pass)



# Ikhana

## Medium Altitude, Very Long Endurance

### *Capabilities*

- **Duration > 24 hours**
- **Ceiling > 40,000 ft**
- **Payload 2,000 lbs, 750 lbs in wing pod**
- **Highly reliable UAS**

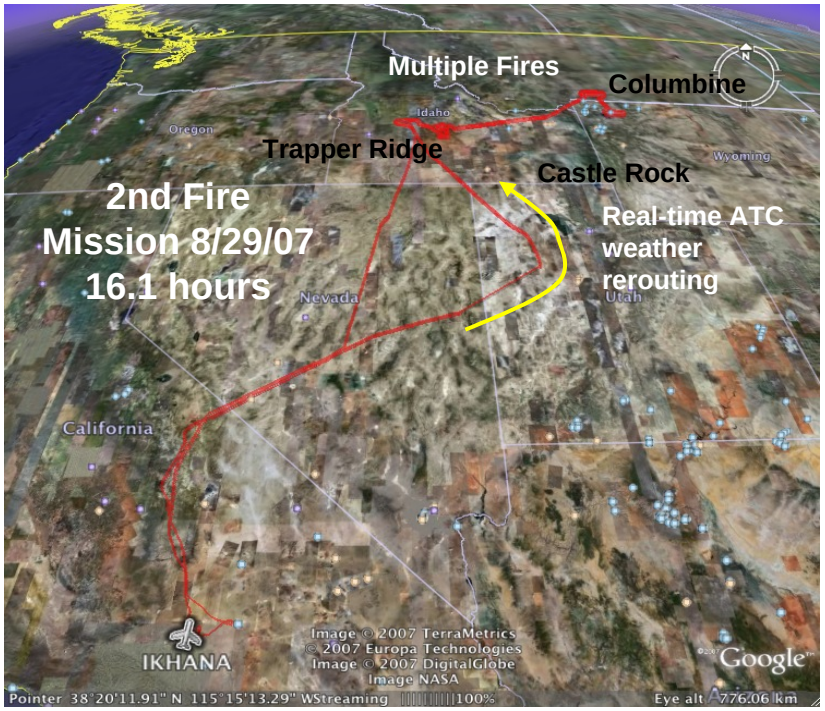
### *Mission Support Features*

- **Deployment ready**
  - **Mobile ground station**
  - **High bandwidth science data link**
  - **Transport by land/sea/air**
  - **Ku Satcom for over the horizon missions**
- **External experiment pod with payload tray for parallel mission processing**
- **Internal payload compartments**
- **Experimenter network and data system**
- **Airborne Research Test System**

# Ikhana, Cont.

*2007 Activity*

- Stand-up of Dryden Operations
  - Received airframe and related equipment
  - Modified GCS for science support
  - Pilot and maintenance crew training
- Wing pod development and testing
- Western States Fire Mission
  - Extensive operations in NAS, close FAA interaction
  - Most complex COA to date
- SoCal emergency wildfire missions





*Outlook*

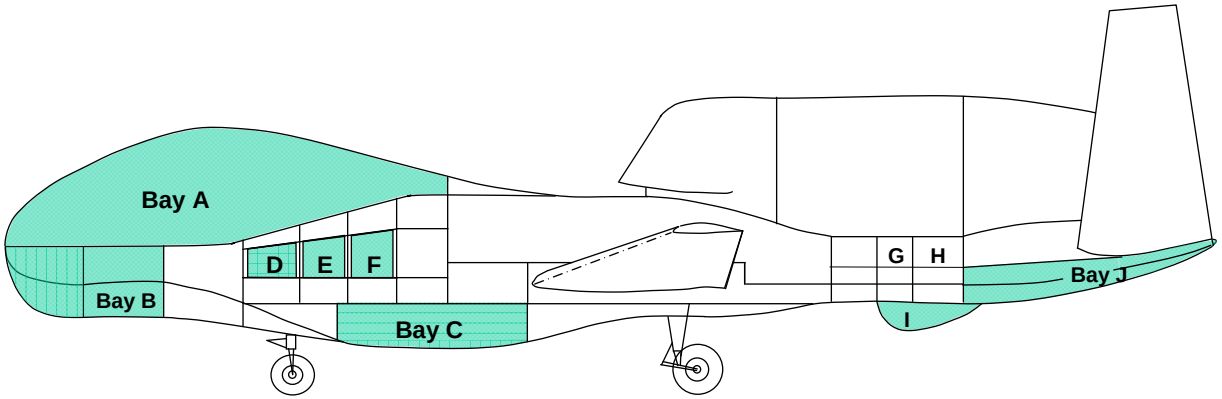
- Follow-on fire mission in 2008 season
- Integration and checkout of Ames' wing pod payload
- Science upgrades
  - Fuselage compartment windows
  - Data system improvement
  - Experimenter's Handbook
- Developing user base to reduce costs to Science

# Global Hawk

## New Capability for Very Long Endurance, High Altitude

### *Capabilities*

- Endurance > 30 hours
- Range > 11,000 nmi
- Altitude 65,000 ft
- Payload > 1,500 lbs
- Highly reliable UAS

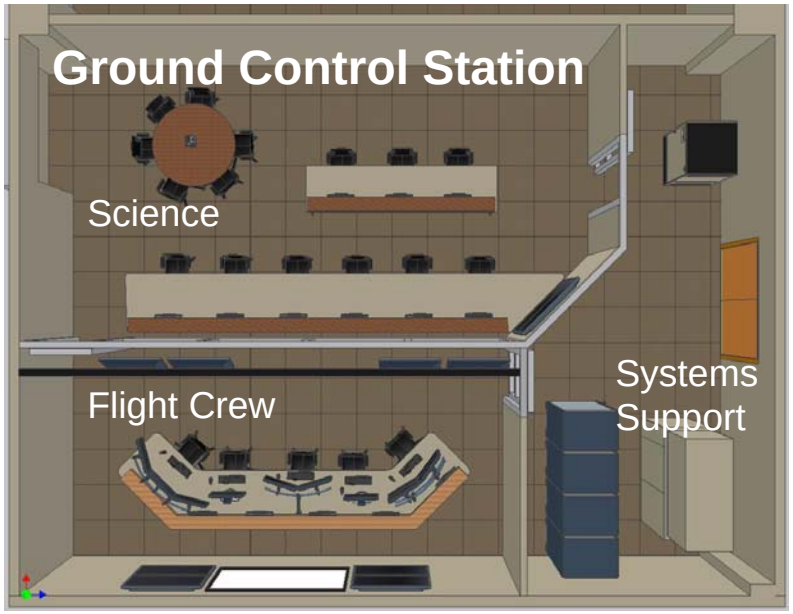



### *Mission Support Features*

- Multiple payload locations.
  - Pressurized and un-pressurized.
  - Can accommodate wing pods (future).
- REVEAL system with ethernet network on the aircraft
- Fully autonomous control system, take-off to landing
- Experiment power
  - 2.0 KW DC
  - 8.3 KVA AC

# Global Hawk - Status

- **Both aircraft transferred to Dryden and located in Hangar 4801**
- **Dryden/Northrop Grumman partnership**
  - **Space Act Agreement**
  - **Stand-up and ops for over 5 yrs**
- **Ground station development underway**




- **Developing project team**
- **Experimenter's Handbook and other documentation in progress**
- **First flight expected by the end of 2008**
- **UAS-AVE is scheduled for Spring 2009**
  - **PI workshop in April 2008 at Dryden**

# Dryden Aircraft Operations Facility


**Palmdale Site 9 complex will provide for :**

- **efficient consolidated operations of platform aircraft**
- **easy access for visiting science teams**

# DAOF

## Science Integration Labs