NASA Global Hawk Project Update and Future Plans
A New Tool for Earth Science Research

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Edwards Air Force Base and NASA Dryden Flight Research Center

Dryden Flight Research Center

NASA Dryden Aircraft Fleet
(as of November 2008)

Edwards Air Force Base
**USAF Global Hawk Block Approach**

**BLOCK 0 (ACTD)**
- 7 Aircraft with ISS (EO/IR/SAR)
- First flight FY98, GWOT in FY02
- 2 Transferred to NASA for Environmental Research in FY07
- 1 USAF Test Bird at Edwards AFB

**BLOCK 10**
- 7 AF; 2 Navy aircraft
- Raytheon ISS (EO/IR/SAR Sensor)
- Operational in CENTCOM Jan 06
- Training & MCE at Beale AFB

**BLOCK 20**
- 6 USAF aircraft
- Raytheon Enhanced ISS (longer range)
- NG-ES LR-100 ELINT
- IOT&E and Fielding in 2009
NGC / NASA Partnership

NASA Space Act Agreement:
- 2008 – 2013: Share costs and system access.
- NASA focus is Earth & Atmospheric Science.
- Northrop Grumman focus is new capability developments and DoD customers.

Currently in Stand-Up Phase
- Assembled new infrastructure.
- Phase inspections and aircraft modifications.
- New ground control station completed
- Flight testing is on-going.

Flight Missions Planned
- January 2010 - Global Hawk Pacific (GloPac) Scientific Campaign.
- Summer 2010 Tropical Storms- NASA Genesis and Rapid Intensification Processes (GRIP).
- 2011 - NASA Jet Propulsion Laboratory UAVSAR.
NASA Global Hawk System

- Two USAF Pre-Production Global Hawk aircraft were transferred to NASA in September 2007. (A third aircraft arrives later this Fall)

- A combined NASA/Northrop Grumman team is maintaining, modifying, and operating the UAS through a 5-year partnership. (2008-2013)

- The first flight of the NASA Global Hawk occurred on 23 October 2009. The flight lasted 4 hours and reached 61,400 ft with no anomalies.

<table>
<thead>
<tr>
<th>Endurance</th>
<th>&gt; 30 hours</th>
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<tbody>
<tr>
<td>Range</td>
<td>&gt;11,000 nmi</td>
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<tr>
<td>Service Ceiling</td>
<td>65,000 ft</td>
</tr>
<tr>
<td>Airspeed (55K+ ft)</td>
<td>335 KTAS</td>
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<tr>
<td>Payload</td>
<td>1,000-1,500 lb</td>
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<tr>
<td>Length</td>
<td>44 ft</td>
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<tr>
<td>Wingspan</td>
<td>116 ft</td>
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Cruise Climb from 56-65K ft (max takeoff weight)
**Typical Mission Profile**

- **Altitude**
  - 65,000 Ft
  - 50,000 Ft

- **Climb**
  - Climb 200 NM Max.

- **Cruise Climb Ingress**
  - 1,200 NM

- **65,000 Ft Loiter Altitude**

- **Egress**
  - 1,200 NM

- **Descent**
  - Descend 200 NM Max.

- **Sensor Area Coverage**
  - 40,000 Sq Mi

**Idle / Takeoff**
- Steady 20Kt Crosswind Component
- 5000 Ft
- 350 Ft
- 50 Ft
- 25 Min. at Ground Idle
- 5 Min. at Takeoff Thrust

**Descent / Land**
- 1 Hour Reserve Loiter at Sea Level
- Steady 20Kt Crosswind Component
- Standard Runway
  - 8,000’ x 150’
Baseline Mission Capability

- Long-duration missions will be conducted in the Arctic, Pacific and Western Atlantic Oceans.

- The arcs represent on-station dwell times before return to base.
Global Hawk Operations Center (GHOC)

Support Equipment Room (SER)

Flight Operations Room (FOR)

14 Customer workstations

Payload Operations Room (POR)

Air Handler

GHOC Operator

Mission Director

Pilot in Command

Flight Support Engineer

Range Safety Officer

PDU
Flight Control and Air Traffic Control Communications Architecture

OmniSTAR
DGPS (Backup)

ATC
DGPS
C^2 & ATC (4 Links)

UHF (LOS)
ATF2 Site
C^2 (Backup)

DFRC GHOC
VHF (LOS)

Inmarsat Earth Station
Inmarsat (Backup)

C^2 (Backup)

EAFB
PSTN
LOS
BLOS

ATC
Payload Integration and Accommodations

- Experiment Interface Panel & Ethernet Switch (6 pairs in the aircraft)
- Payload Integration Software T&E
- Wing Pods (future capability)
- Mounting Rails
- Bay Under the Nose
- Pallets and Hatches
- Mounting Hard Points
Payload Integration and Accommodations (cont)

On-Site Customer Accommodations

- Re-configurable work area in the hangar.
- Access to meeting room, phones, fax, copy machine, printer.
- Wireless internet.
- Shop support.
- Environmental testing support.
- NASA and Northrop Grumman Mechanics and Technicians.
- Hangar is networked to the Global Hawk Operations Center.
NASA/NOAA Partnership

NOAA and NASA Partnership
- Joint participation in science data gathering missions.
- NOAA provides scientific instrumentation to compliment NASA instrumentation.
- 3 year agreement.

CDR Phil Hall on 4 Year Detail to Dryden
- Deputy Project Manager.
- Global Hawk pilot.
- Mission planning and coordination.

Dropwindsonde Capability
- NOAA is funding the development of a dropwindsonde capability.
- NCAR/NOAA partnership.
Global Hawk Pacific Science Campaign (GloPac)

- Flights planned for Winter 2010.
- Flights will be conducted over the Pacific Ocean, and possibly over parts of the Arctic.
- 11 instruments, NASA and NOAA sponsored.

Proposed Flights

COA Boundary

Science Team
Global Hawk Pacific (GloPac) Payloads

1) Airborne Compact Atmospheric Mapper (ACAM) -- Cross-track scanning spectrographs of NO$_2$, O$_3$, & aerosols.
2) Cloud Physics LIDAR (CPL) -- Backscatter LIDAR for hi-res profiling of clouds & aerosols.
3) Focused Cavity Aerosol Spectrometer (FCAS) -- Aerosol size and concentration measurements.
4) Meteorological Measurement System (MMS) -- Science quality aircraft state variable measurements.
5) Microwave Temperature Profiler (MTP) -- Passive microwave radiometer meas. of O$_2$ thermal emissions.
6) HiDef Video System (HDVis) -- Time-lapse nadir color digital imagery with georeferencing.
7) Nuclei-mode Aerosol Size Spectrometer (NMASS) -- Aerosol size and concentration measurements.
8) NOAA UAS Ozone (Ozone) -- Dual-beam UV photometer for accurate O$_3$ measurements.
9) UAS Chromatograph for Atmospheric Trace Species (UCATS) -- Dual gas chromatographs for N$_2$O, SF$_6$, H$_2$, CO, & CH$_4$ meas.
11) UAS Laser Hygrometer (ULH) -- In-situ hi-accuracy atmospheric water vapor measurements.
Science Objectives and Missions

- First demonstration of the Global Hawk unmanned aircraft system (UAS) for NASA and NOAA Earth science research and applications.

- Validation of instruments on-board the Aura satellite.

- Exploration of trace gases, aerosols, and dynamics of remote upper Troposphere / lower Stratosphere regions.

- Sample polar vortex fragments and atmospheric rivers.

- Risk reduction for future missions that will study hurricanes and atmospheric rivers.
Proposed Payloads

UAV-SAR (JPL)
Reconfigurable polarimetric L-band SAR designed for repeat pass deformation measurements (currently on NASA G III).

HIWRAP (GSFC)
Ku and Ka band radar for the measurement of wind and rain profiles.

Dropwindsonde Dispenser (NOAA)

HIRAD (MSFC)
Hurricane Imaging Radiometer for high resolution measurements of ocean surface vector winds.

HAMSAR (JPL)
Microwave Sounder providing 3D measurements of temperature and Water vapor content.
Future Mission Capability
With a Portable Ground Station
NASA Dryden owns two Global Hawk aircraft, soon to be three.

A ground control station has been constructed and certified.

Flights within the EAFB range began in October 2009.

Customer flights begin in 2010.
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