National Aeronautics and Space Administration

NASA Global Hawk Overview

Armstrong Flight Research Center

June 2017

www.nasa.gov

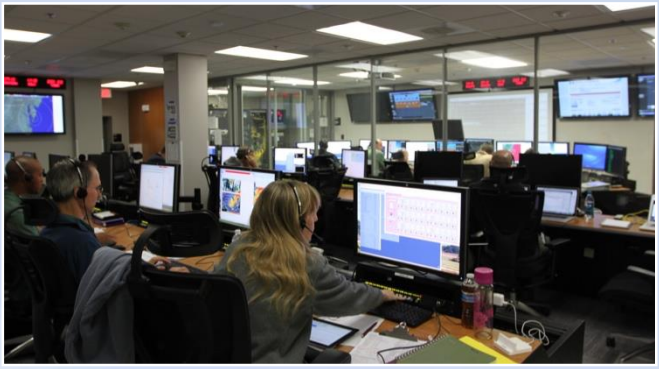
Summary and Capability

- NASA/Northrop Grumman Corporation (NGC) team maintains, modifies, and operates two aircraft through a partnership established in 2008 (renewed, 2013)
- NASA has been flying Global Hawk aircraft for airborne Earth Science research since 2010
- To date, ~168 missions have been flown, with a total of 2,100+ flight hours
- Autonomous aircraft are remotely operated from either NASA Armstrong, NASA Wallops Flight Facility (WFF), or remote locations via portable flight control station

Endurance	24-26 hours for typical missions; 28.6 hours demonstrated
Range	10,000 nautical miles (nmi)
Service Ceiling	65,000 feet, < 50% available aircraft payload power 62,500 feet, > 50% available aircraft payload power
Airspeed (55,000+ feet)	335 knots true airspeed (KTAS)
Payload	1,200 pounds demonstrated
Length	44 feet
Wingspan	116 feet

Asset Overview

Operational Aircraft



Global Hawk Operations Center – East
(Wallops Flight Facility)

- NASA Armstrong Global Hawk tail number (TN) 871 is now retired
- Armstrong's Block 10 Global Hawk TN 874 is being refurbished

Global Hawk Operations Center (GHOC)
(NASA Armstrong)

Portable Ground Systems

Spares Aircraft

Operations Overview

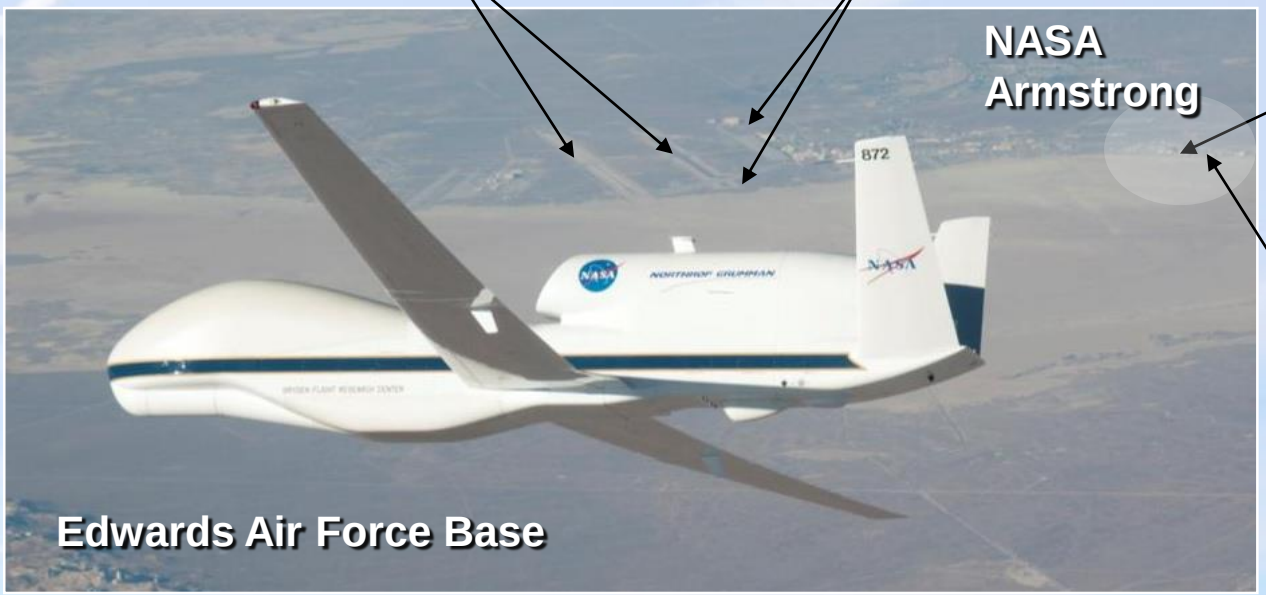
Edwards Air Force Base (EAFB)/NASA Armstrong

EAFB Runways

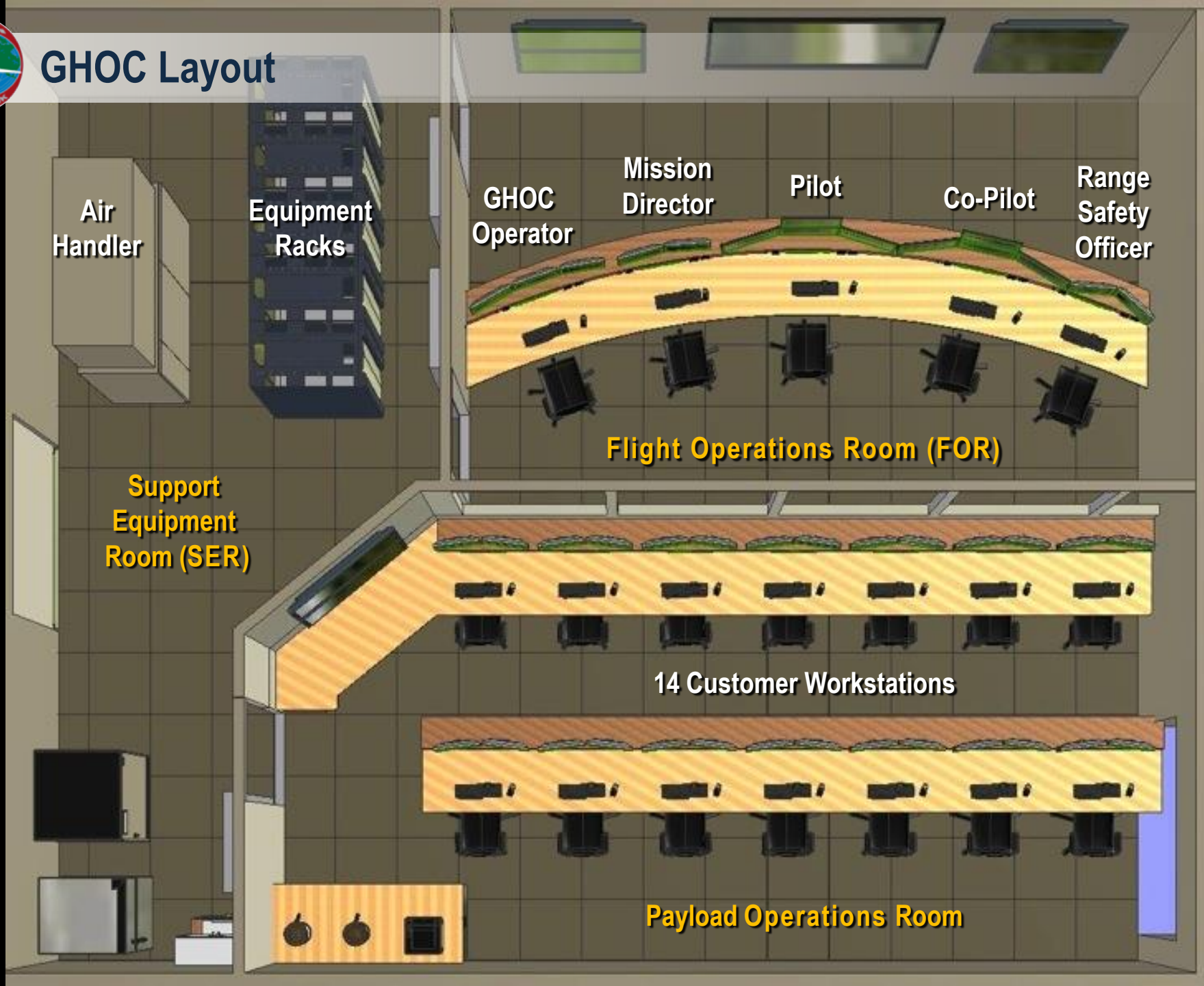
Mission Staging Locations

Maintenance Hangar and Instrument Laboratory

Flight Operations Center

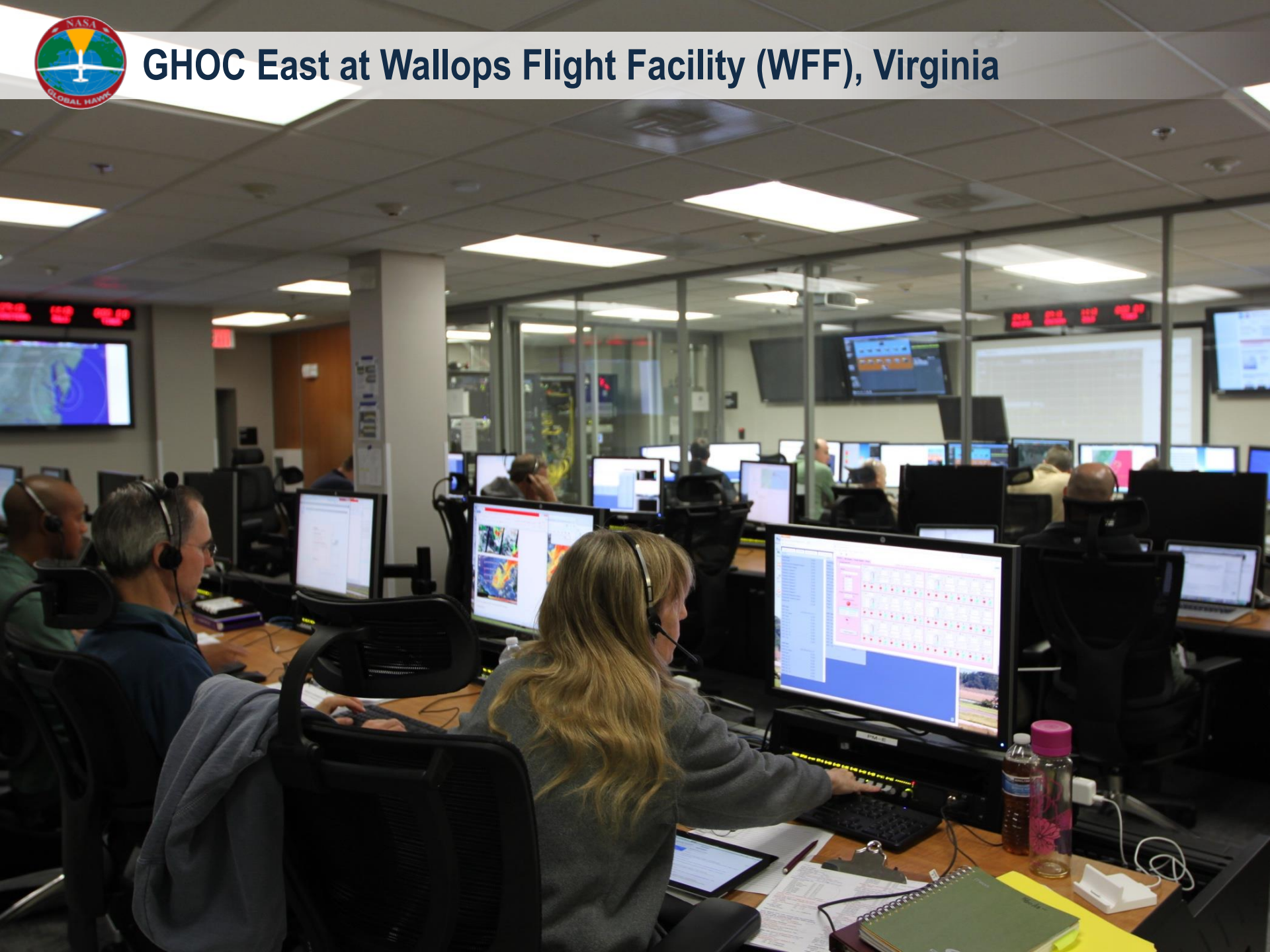


GHOC Layout


Air Handler
Equipment Racks
GHOC Operator
Mission Director
Pilot
Co-Pilot
Range Safety Officer
Flight Operations Room (FOR)
Support Equipment Room (SER)
14 Customer Workstations
Payload Operations Room
Facility Entrance

GHOC Fully Staffed During a Hurricane Overflight

GHOC East at Wallops Flight Facility (WFF), Virginia



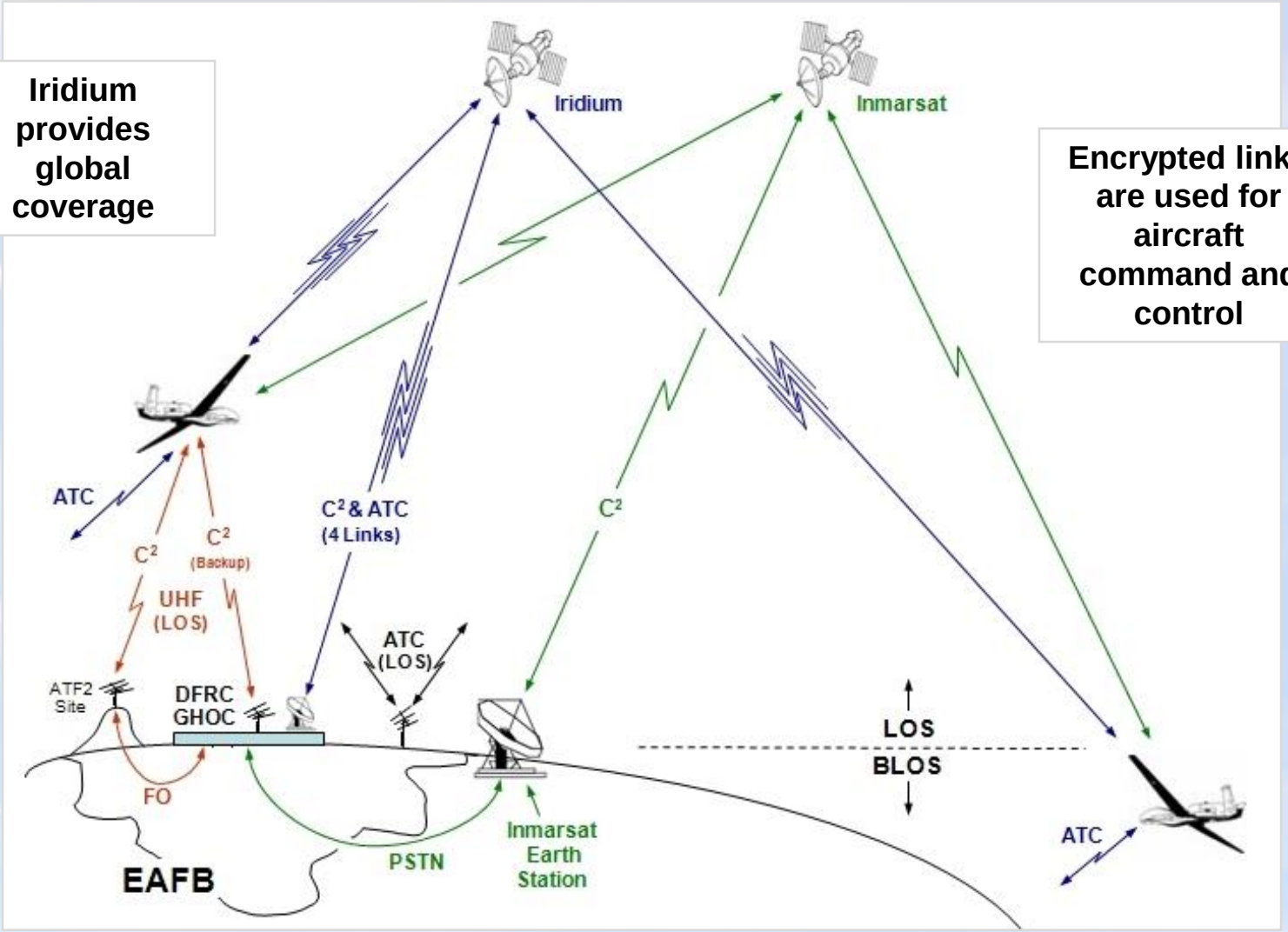
Portable Ground Control Station (GCS)

Suite used for deployed operations

Aircraft Flight Control and Air Traffic Control

Communications architecture

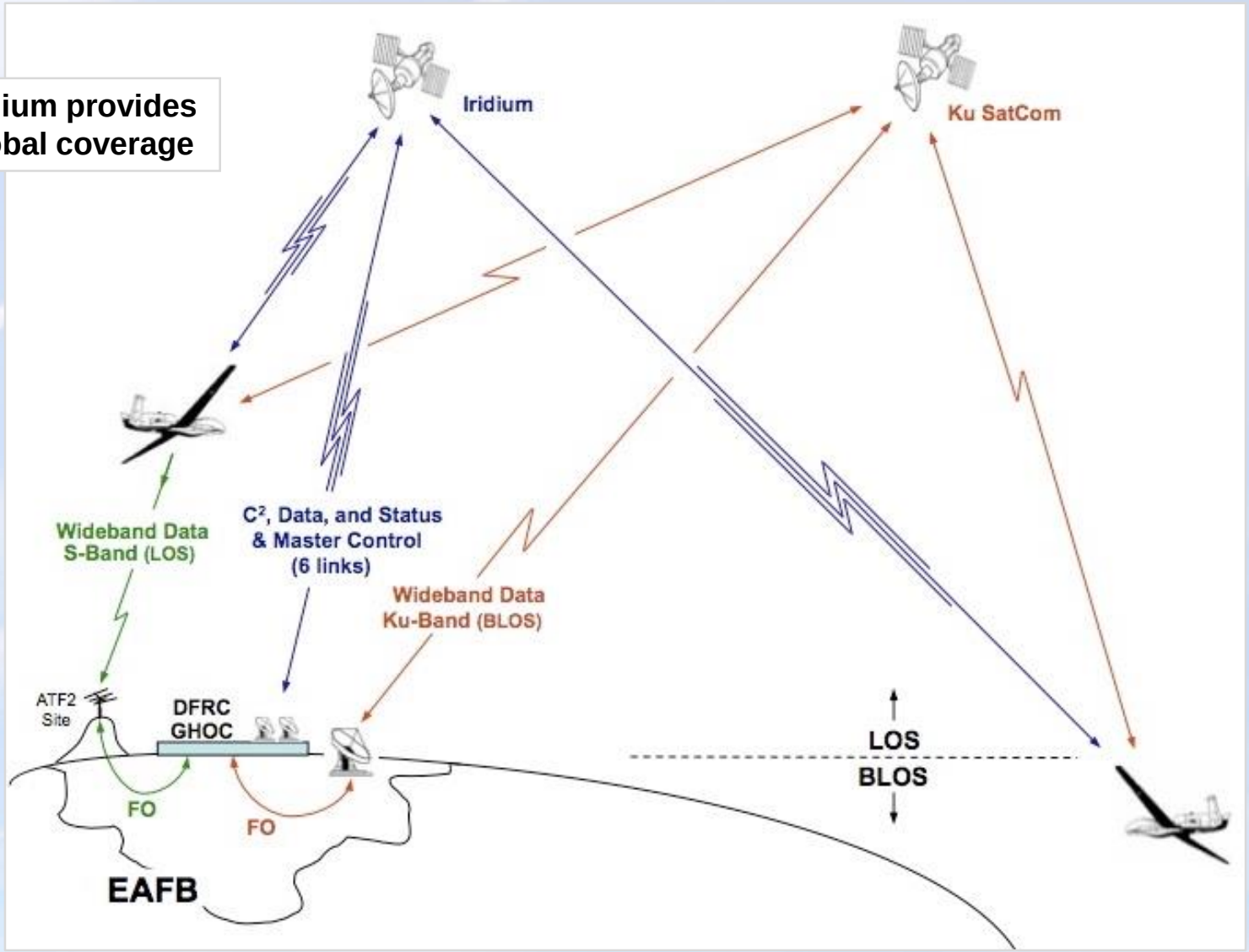
Iridium provides global coverage



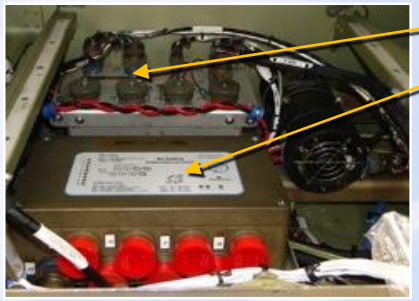
Encrypted links are used for aircraft command and control

Payload Communications Architecture

Iridium provides global coverage



Payload Integration and Accommodations



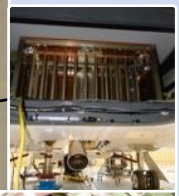
Payload power and aircraft data

Payload command and control (C2) and payload data

Experiment Interface Panel and Ethernet Switch
(six sets distributed on aircraft, each set supports up to four payloads)

Payload Integration Test Bench
(Pre-Integration Checkout)

Tail Zone



Mounting Hard Points

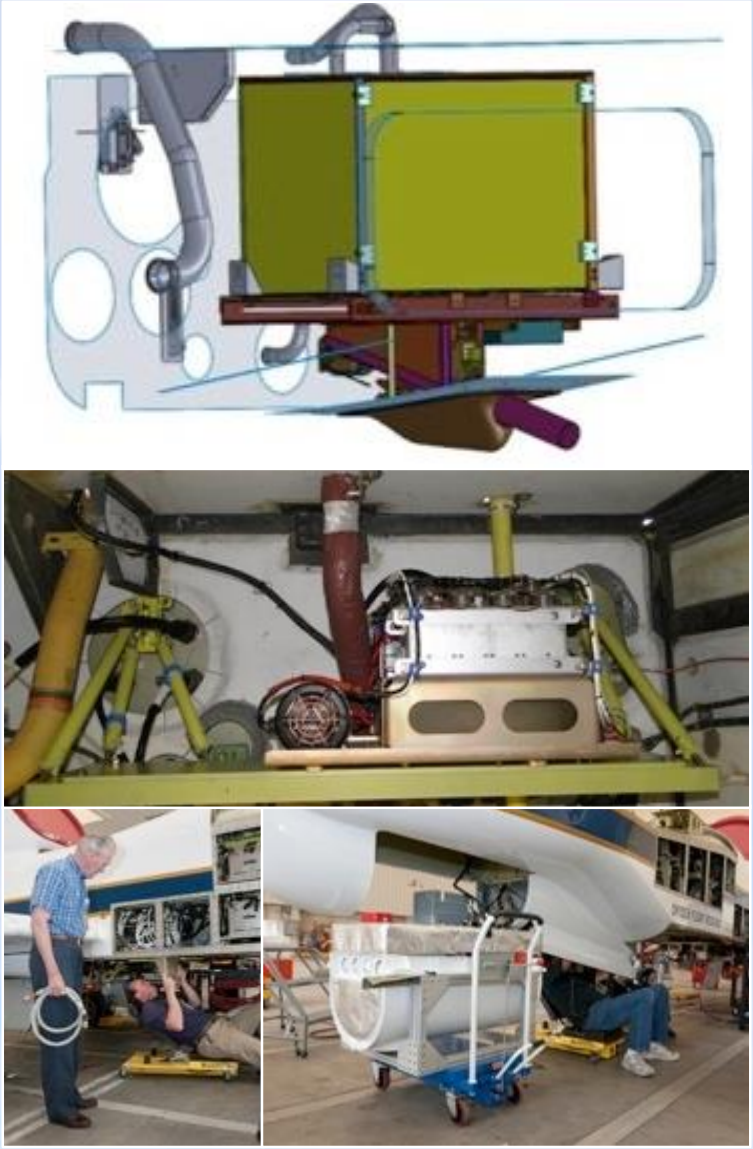
Mounting Rails

Bay Under Nose

Pallets and Specialized Hatches

Payload Integration Process

- Site visit at customer's location: initial discussion of payload and operational concept
- Receipt of payload solid models and design/integration data from customer
- Integration engineering (performed by NASA Armstrong and/or NGC)
- Avionics harness fabrication at NASA Armstrong
- Fabrication and fit-check of payload mounting structure
- Initial mechanical integration on aircraft



Payload Integration Process

- Environmental tests on payloads, as required
- Electrical integration on payload test bench
- Final integration on aircraft
- Payload communications and payload data telemetry verification in the GHOC
- Combined system test (CST) with all aircraft and payload systems operating
- Range check-out flight
- Ready for operational flights

Global Hawk Science Flights

GloPac
2010

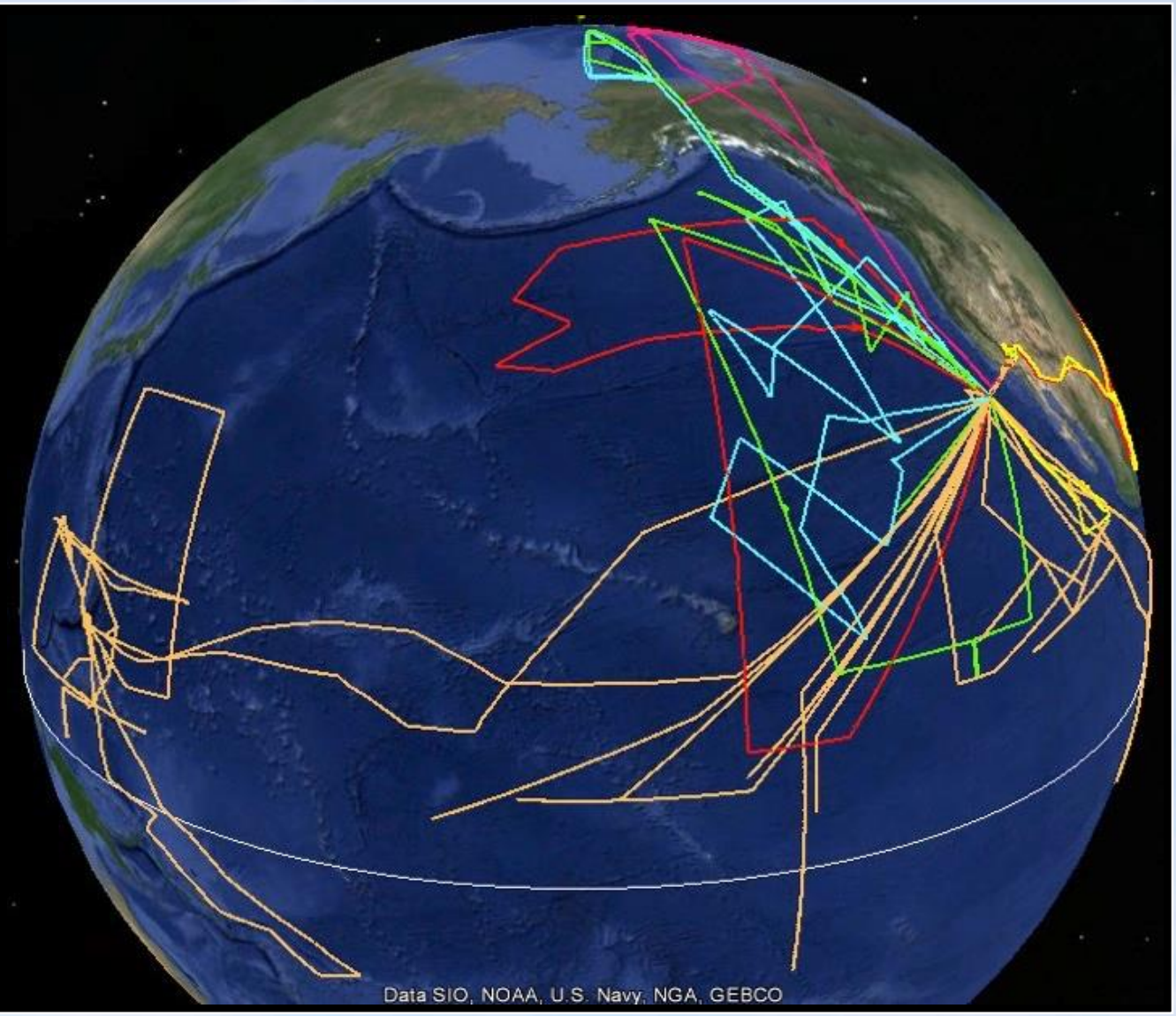
GRIP
2010

WISPAR
2011

HS3
2011, 2012, 2013

ATTREX
2011, 2013, 2014

IceHawk
2013



Global Hawk Science Flights

GloPac
2010

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ATTREX
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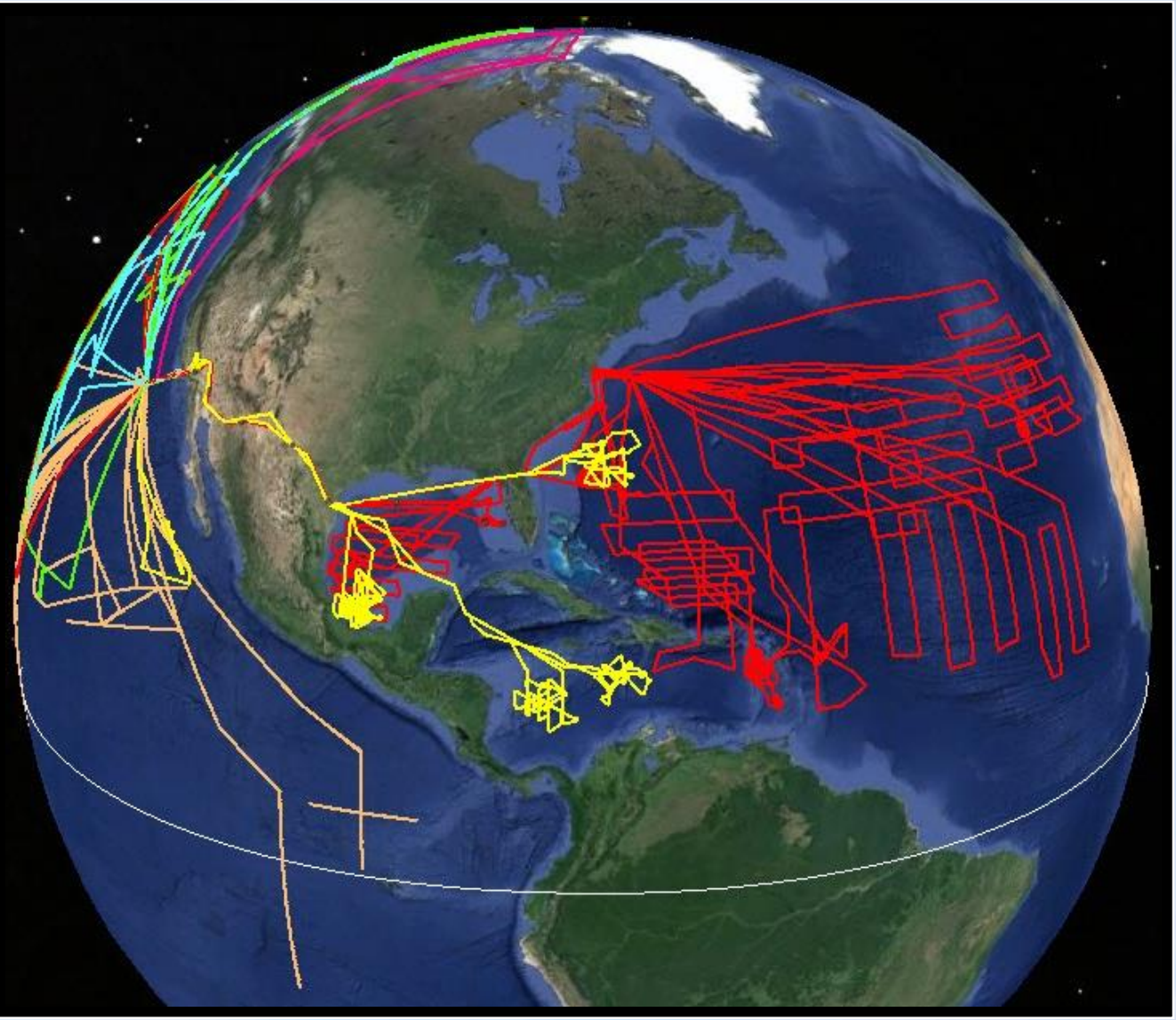
IceHawk
2013

SHOUT (NOAA)
2015, 2016



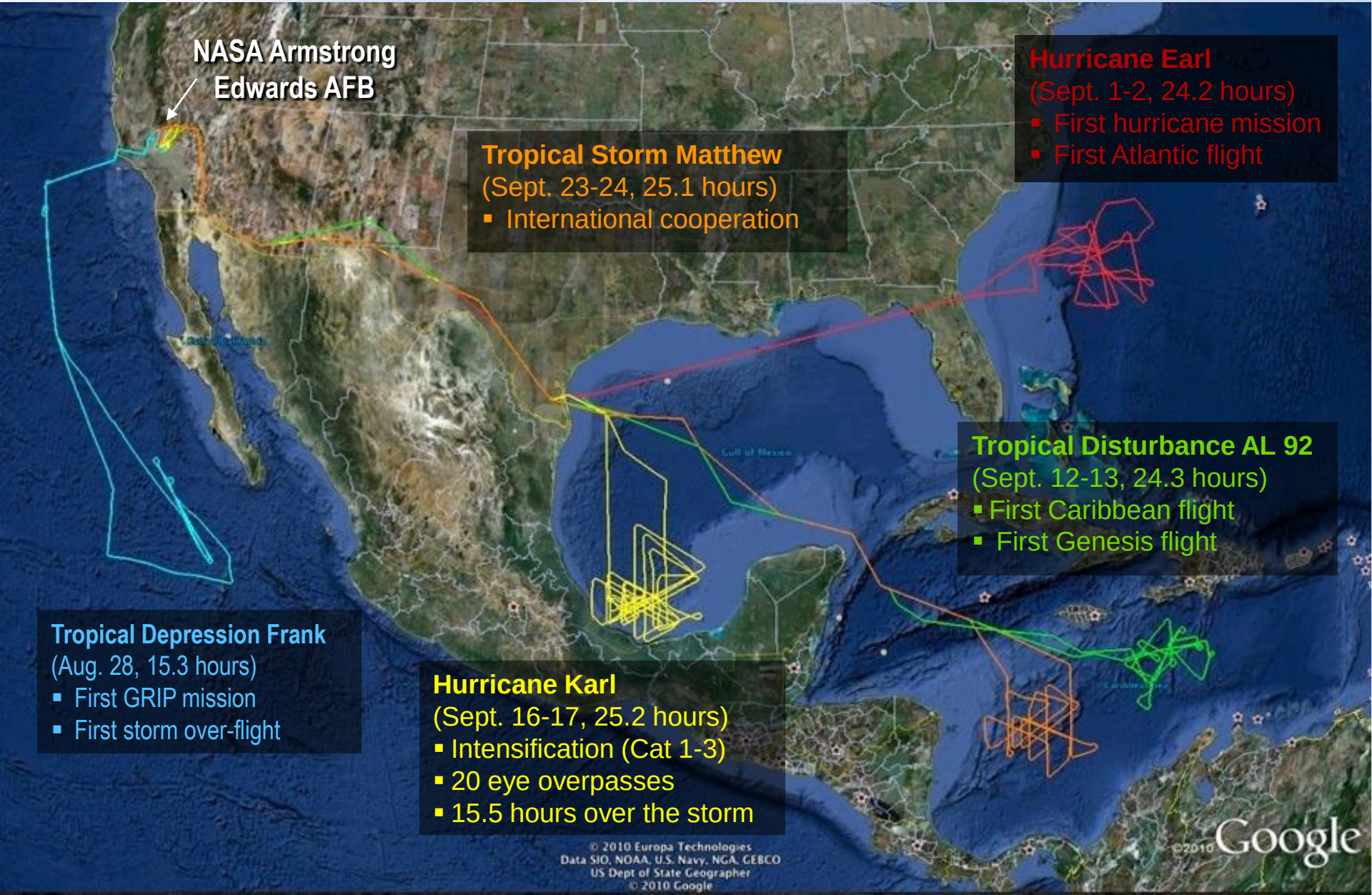
Global Hawk Pacific (GloPac) Flights

14.1 hours, 4,600 nmi,
61,200 feet

24.3 hours, 8,000 nmi,
62,300 feet

28.6 hours, 9,700 nmi,
65,200 feet

Genesis and Rapid Intensification Processes (GRIP) 2010 Flights



Winter Storm Pacific and Atmospheric Rivers (WISPAR) Overview

February-March 2011

- First National Oceanic and Atmospheric Administration (NOAA)-sponsored Global Hawk Earth Science campaign
- Two instruments were installed on the aircraft: High-Altitude Monolithic Microwave Integrated Circuit Sounding Radiometer (HAMSR) and Advanced Vertical Atmospheric Profiling System (AVAPS)
- Three science missions were flown, with a total of 70 flight hours
- First operational dropsonde deployment from any unmanned air vehicle (UAV) (70 were deployed during a single flight)

Dropsonde deployment

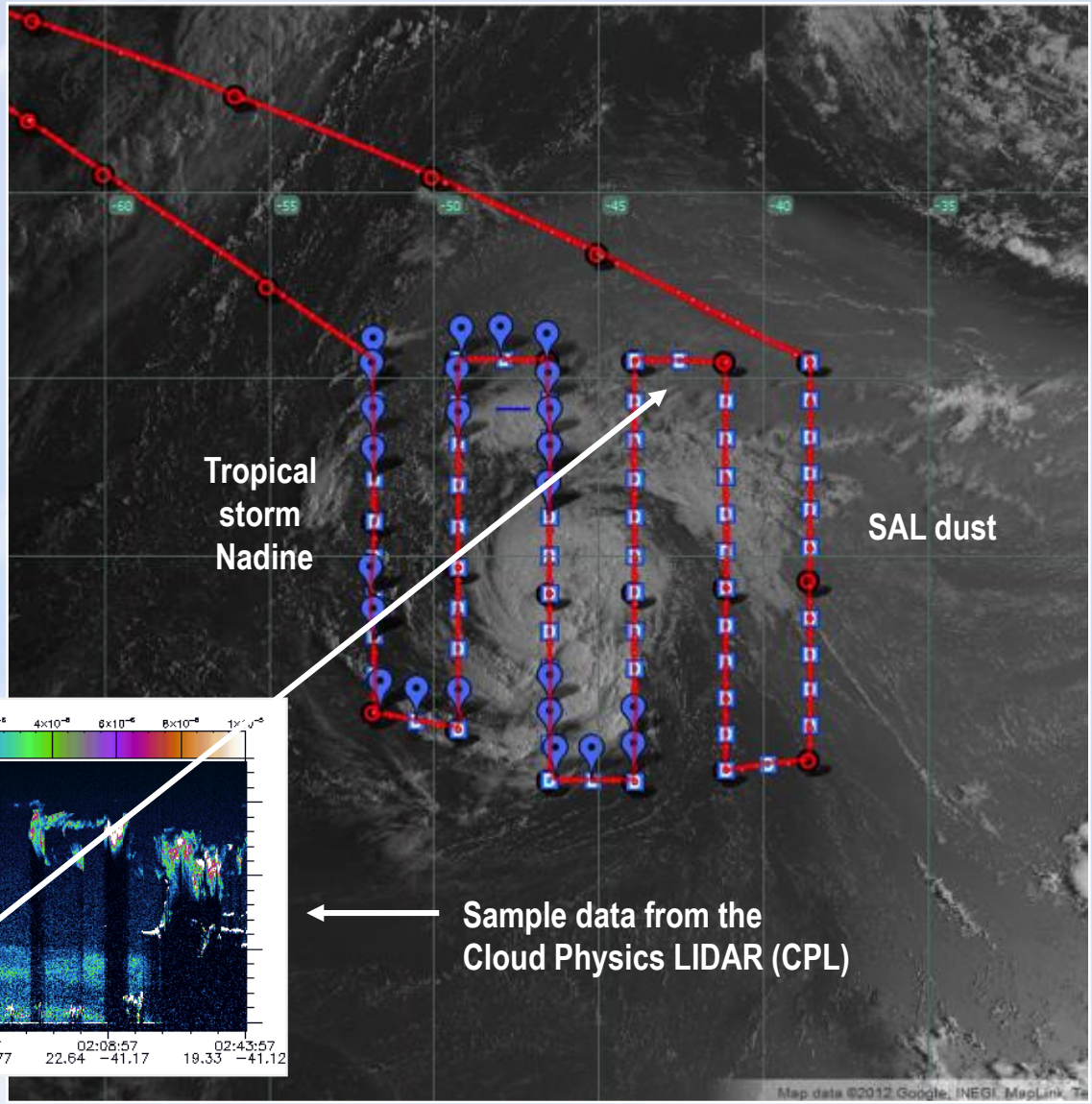

Dropsonde on chute


Flight tracks

HS3 Explored Nadine's Interaction with Saharan Air Layer (SAL)

September 11-12, 2012

Warm, dry, dusty air wrapped around the eastern and northern side of Nadine, but didn't get into the storm circulation



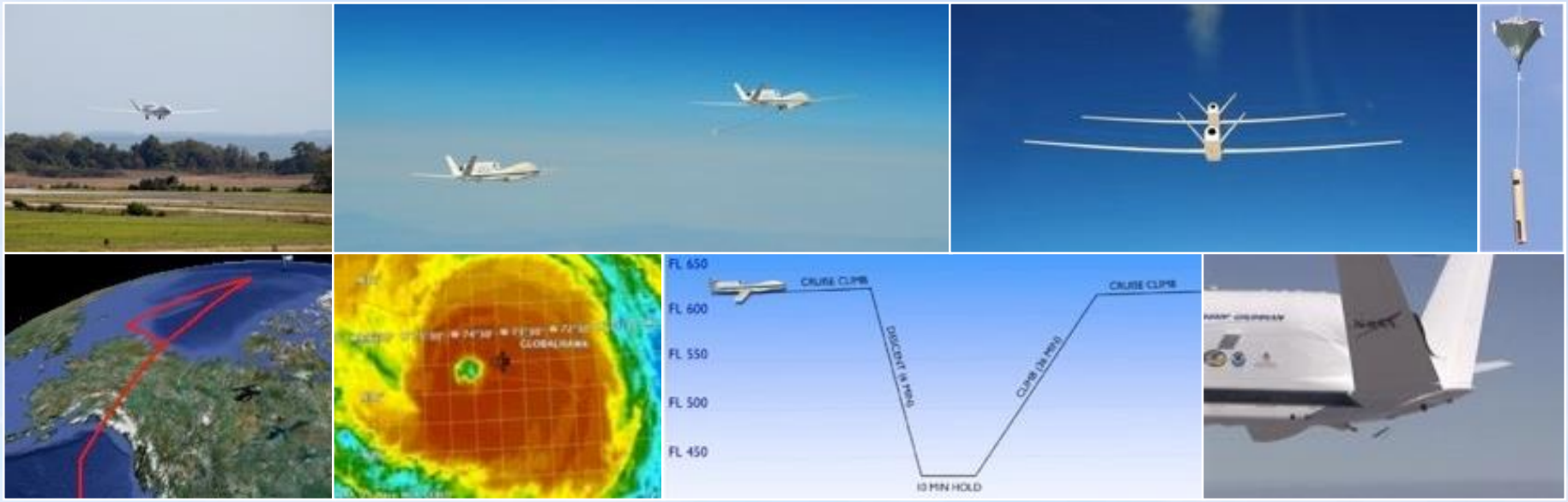
IceHawk

December 2013

- UAV Synthetic Aperture Radar (UAVSAR) was integrated onto the aircraft
- A single flight was conducted over the Pacific Ocean and Canada
- Flight marked the first UAVSAR flight outside of the EAFB range and the first NASA Global Hawk flight over a foreign country
- Coordination with the Canadian Government was straightforward
- IceHawk flight was funded by NGC

Global Hawk 'Firsts' Accomplished by the NASA/NGC Team

1. Flights above 70 degrees latitude; the aircraft has reached 85 degrees N three times
2. Flights over hurricanes and severe storms, including a single flight that included 15.5 hours over a hurricane and 20 over-flights of the eye
3. Vertical profile maneuvers during science flights for the collection of atmospheric data
4. Release of dropwindsonde weather instruments in the national airspace system (first Federal Aviation Administration [FAA] approval for release of stores from a Global Hawk)
5. First Global Hawk operations at WFF and first science flights from Andersen Air Force Base, Guam
6. Autonomous formation flight of two Global Hawk aircraft, which were as close as 30 feet apart while flying in formation for 2.5 hours



Global Hawk 'Firsts' Accomplished by the NASA/NGC Team

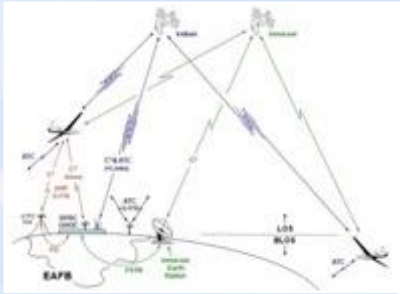
7. Implementation of an independent payload power and date telemetry system on Global Hawk
8. Flight of the Active Electronically. Scanned Array (AESA)-360 radome on a Global Hawk aircraft (Radome provides greater volume for instruments under the aircraft and has been used to house the High-Altitude Imaging Wind and Rain Airborne Profiler [HiWRAP] and Twilite instruments)
9. Implementation of wing-mounted instruments on an Advanced Concept Technology Demonstration (ACTD) aircraft (Hawkeye for ATTREX 2014)
10. Ku system implementation for payload data telemetry, payload C2, and Ku air traffic control (ATC)
11. Implementation of Airborne Research Test System (ARTS) on a Global Hawk aircraft
12. Implementation of a rear payload mounting capability in the tail cone and on the bottom of the aircraft under the rear pressurized compartment

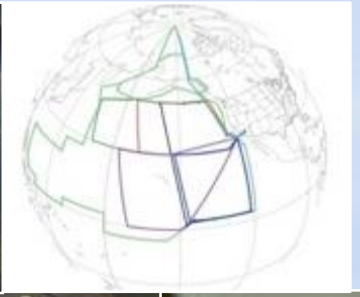





Global Hawk 'Firsts' Accomplished by the NASA/NGC Team

13. Aircraft C2 with Iridium communications links
14. ATC communications with Iridium communications links
15. Dissemination of high-definition pictures from the aircraft to the public in real time (pictures and the flight track are shown on a publicly available website for public awareness of the science missions)
16. Largest geographical Certificate of Authorization (COA) ever granted by the FAA (GloPac COA covers most of the Pacific Ocean north of the Equator, and extends to the North Pole)
17. Most complex mission plan ever created (GRIP mission plans contains many routes to ensure options for avoiding restricted areas and avoiding atmospheric conditions outside of aircraft limits
18. Development of a new ground control station, based on NGC's Common System Architecture




Mission Planning and Pilot Discussion

- Kyle Salling (NOAA) creating COAs, airfield landing agreements, and country border notifications
- Erick Munoz (NGC) mission planning

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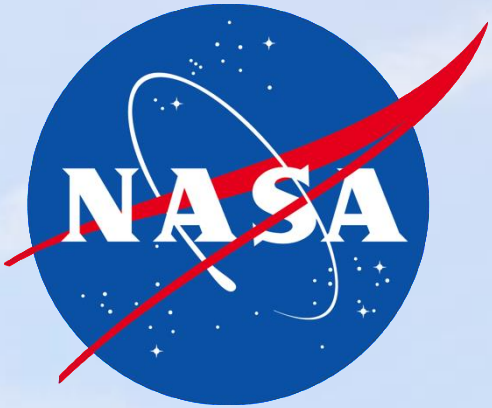
Tropical Depression Frank, August 28, 2010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