NASA Science Mission Directorate,
Earth Science Division,
Airborne Science Program Overview

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Airborne Platforms Provide Opportunities To Study the Earth System and its Components

- Help bridge scales between the (typically) global scales of satellite observations and the very local observations of surface-based in situ measurements.
- Way of doing comprehensive process-oriented studies that can focus on specific regions and times of interest.
- Initial sense about Earth system parameters and their variability before satellite observations are possible.
- Focused calibration/validation observations (e.g., coincident measurements) for satellite remote sensing.
- Opportunities to test new instrumentation in an environment that can provide some similarities to space-based platforms/viewing.
- Targeted observations when needed for applications (e.g., disaster response).
- Opportunities for training of investigators who see through all phases of a project (instrument development, operation/use, analysis/interpretation, results dissemination, public communication).

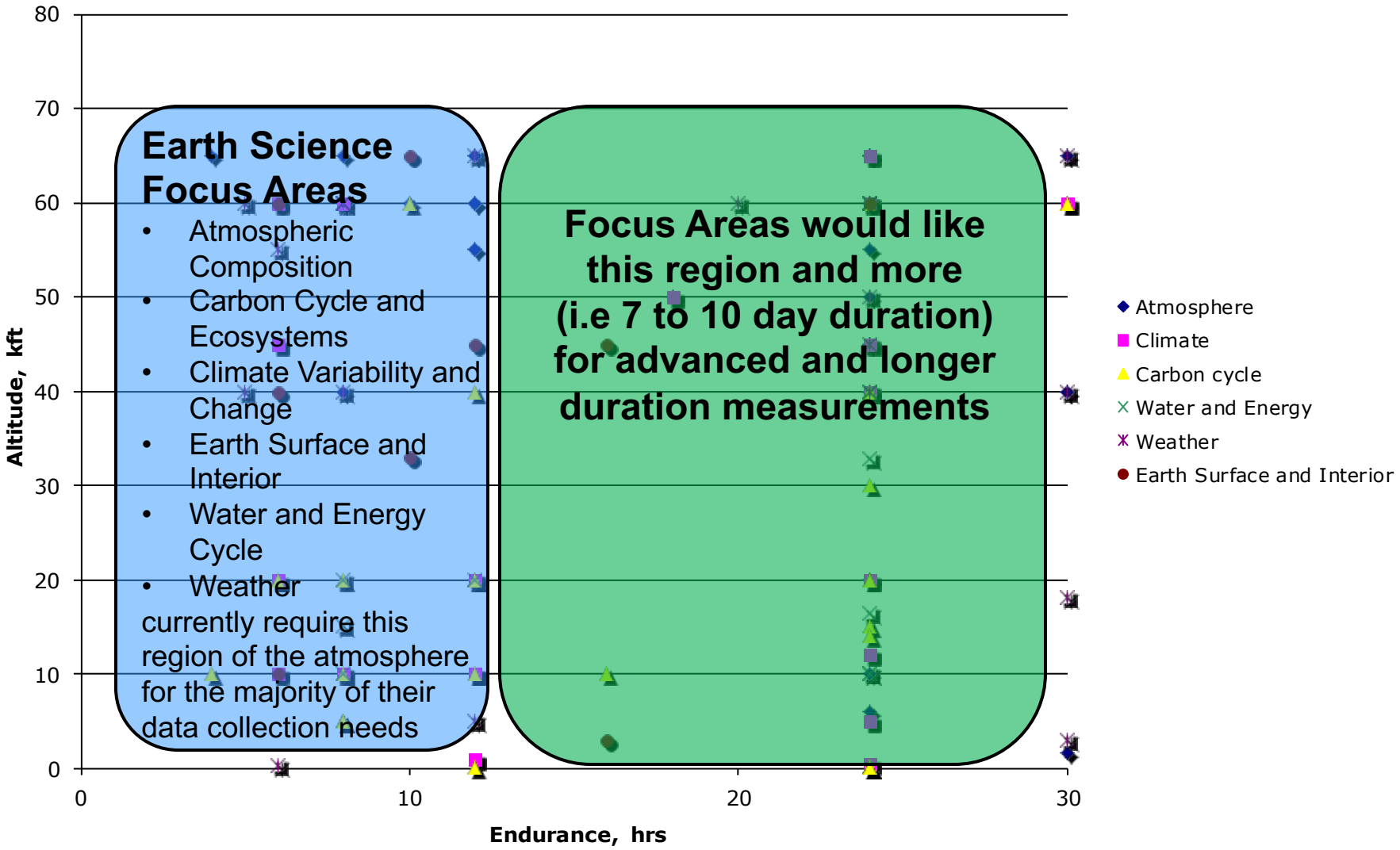
NASA Airborne Science Program

- Provides airborne capability to meet Earth Science requirements utilizing NASA, OGA, and commercial platforms
  - Capability maintained/added/removed based upon budgets and requirements
  - Requirements vetted yearly
  - Actively looking for options
  - https://airbornescience.nasa.gov/

- Responsive to Earth Science airborne platform requirements
  - Over 300 airborne instruments and counting….
  - Over 3100 Earth Science flight hours in FY18

Earth Science Requirements

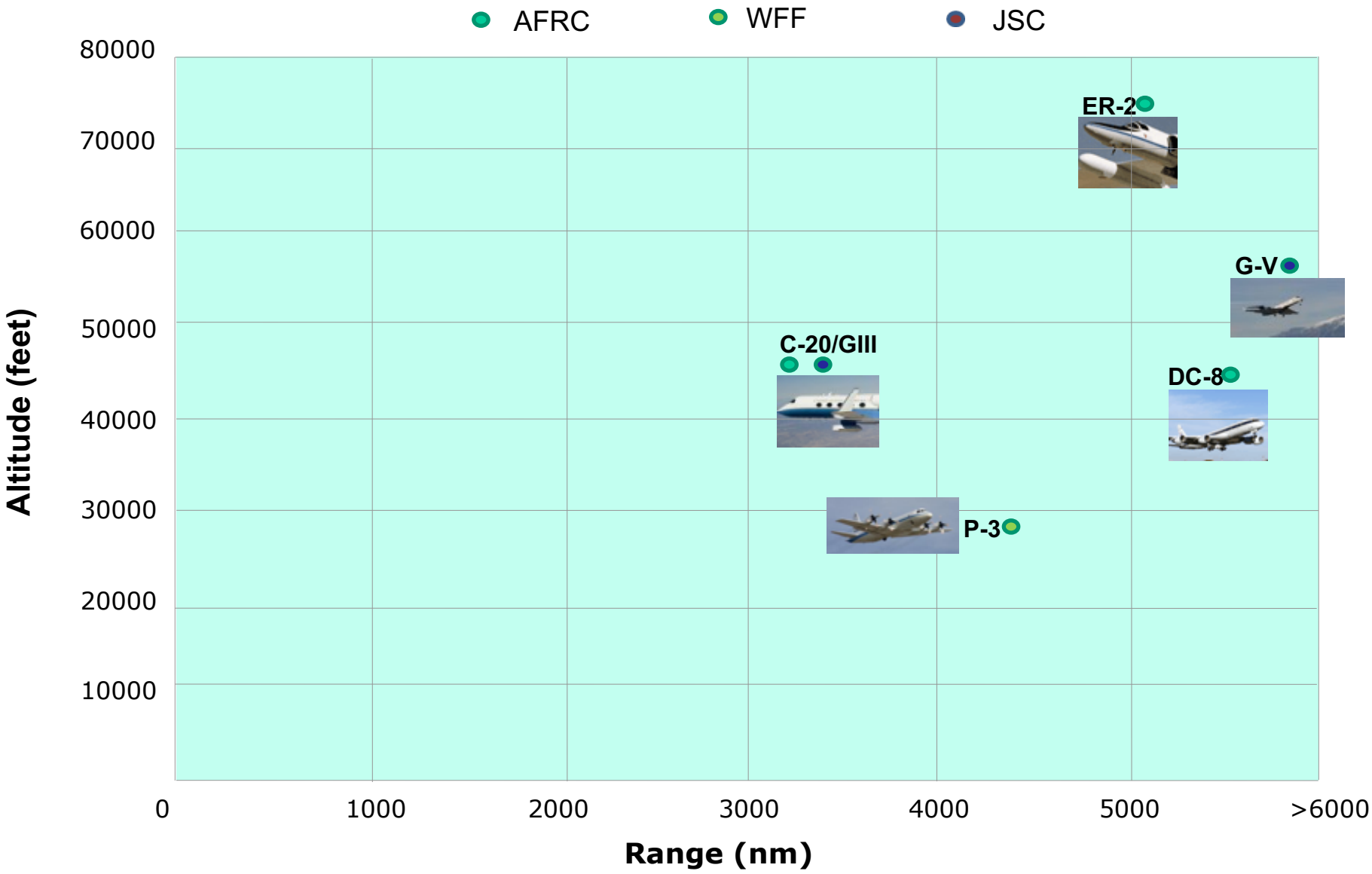
Platform performance required/desired from science community



Bottom Line – cost effective data collection from 500 - 70kft and from 2 - 30 plus hours and beyond (7 to 10 days)


NASA

NASA ESD Core Funded Aircraft

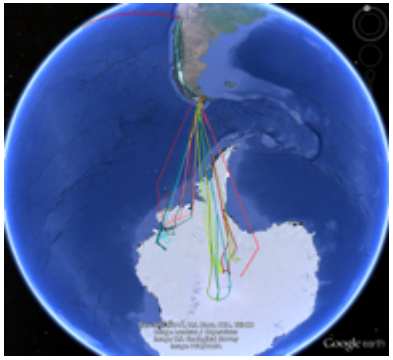


Recent Accomplishments

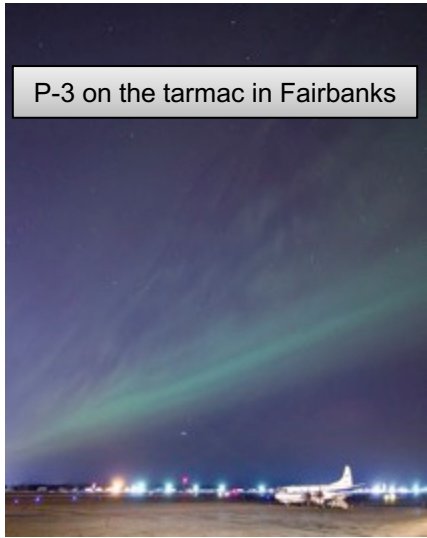
(as of May 2019)

- Hours Flown –over 3800 in FY17, over 3100 in FY18
- Completed Major Campaigns
  - Operation IceBridge: Antarctic and Arctic deployments
  - GV first science: SWOT and GEDI cal/val
  - EVS-2: Act-America, ATom, OMG, ORACLES
  - Aeolus cal/val
  - ABoVE continuity
  - Long Island Sound Tropospheric Ozone Study
  - HysplRI CA and Hawaii
  - GLiHT Forest Health
  - Kilauea Response
  - ACEPOL
  - Airborne Snow Observatory
  - Multiple UAVSAR ESI investigations
  - SARP
- Major Platform Updates
  - GV completed two missions, two upcoming
  - Acquired GIII, mods ongoing
  - C-20A maintenance
  - ER-2 CARE ongoing

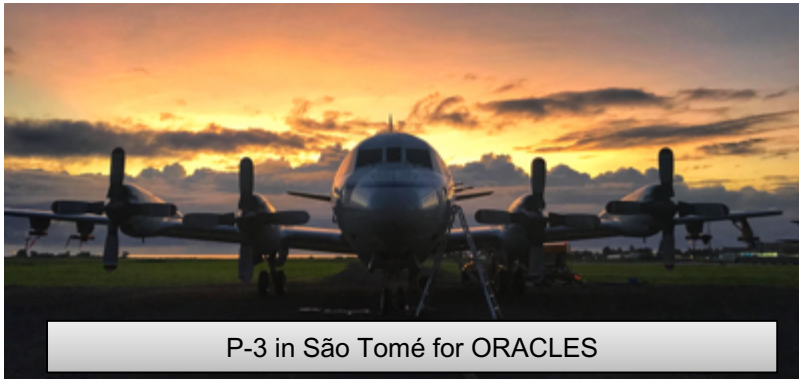
ATOM Science Team


DC-8 Antarctic Flights 2018


G-V and team in Houston


P-3 on the tarmac in Fairbanks

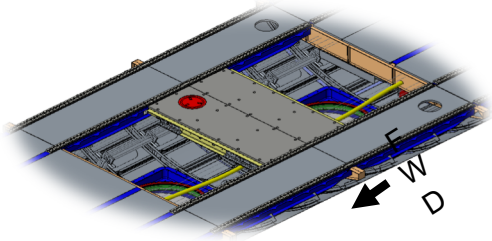

ER-2 in Hawaii for Hyspiri/HyTES

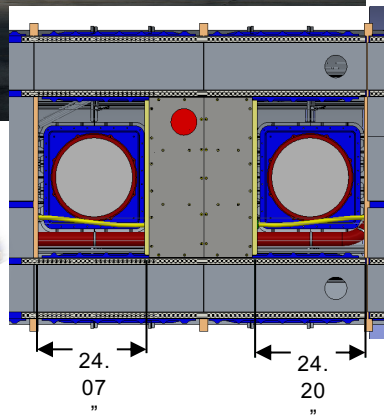

P-3 in São Tomé for ORACLES

Gulfstream V (NASA N95NA)

- Gulfstream V (N95NA)
  - Serial 672, built in 2002
  - Service Ceiling: 51,000ft
  - Max Speed: Mach 0.885
  - Normal cruise range: >5,000nm
  - Max Payload: 8,300lbs

➢ Two downward-facing viewports installed in forward cabin
  - FS 290.5 and 339.5
  - 20.75” x 20.75” opening
    - ⇨ Window viewable area will be smaller, circular
  - Includes mounting ring capable of ~350lb load (minus window pack)
  - Sealing blank for non-science flights





Gulfstream III (NASA 520)
Aircraft Metrics

- Gulfstream III
  - Serial 478, built in 1986 as U. S. Air Force C-20B
  - Service Ceiling: 45,000 ft
  - Max. Gross Weight: 69,700 lbs
  - Max. Mission Duration: 8.5 hr
  - Max. Cabin Payload: 2610 lbs
  - Max. Speed: Mach 0.85
  - Normal Cruise Range: 3767 n.mi.

Two Identical Portals

- 18.16 x 18.16 in. portal “see through” opening
- 19.00 x 19.00 in. vertical portal flange
- 21.00 x 21.00 in. mounting flange

SIERRA
Sensor Integrated Environmental Remote Research Aircraft

Phil Schulyer, SIERRA crew chief with the aircraft carrying a GP-SAR antennae and modified nose

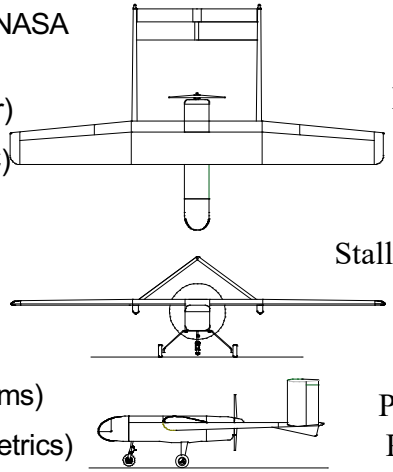
•SIERRA complements other UAVs in the NASA science fleet specializing in dangerous, low altitude missions that require larger payload capacity than typical small UAVs

• Airframe designed by NRL; systems development and integration at NASA Ames

• Ship 1 operated Oct 2008-Jul 2013

• Payloads flown include:

- VIS/NIR Hyperspectral Imager (NASA Ames)
- LIDAR Profilometer (CU-Boulder)
- Ocean Color suite (NASA GSFC)
- MMS (NASA Ames)
- CO2/CH4/H20 (Los Gatos Research/Picarro)
- C-Band SAR (Artemis/BYU)
- UHF/L-band SAR (Mirage Systems)
- Flux-gate Magnetometer (Geometrics)

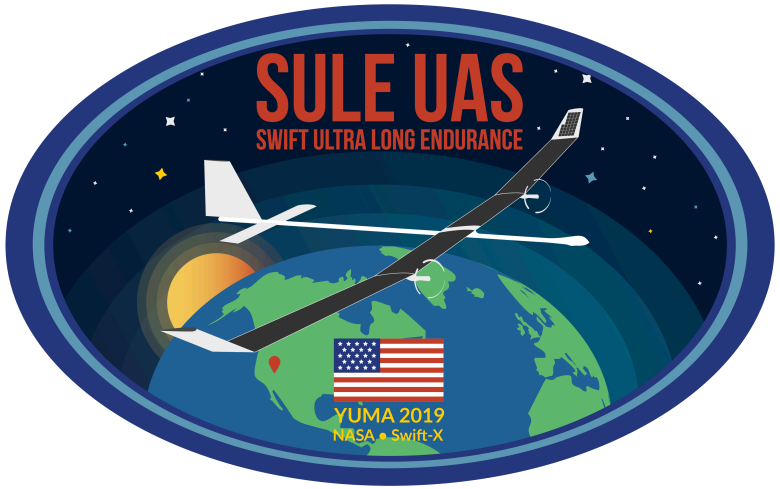


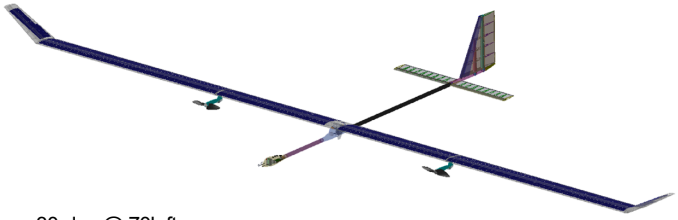
Wing Span	**20 ft.**
Length	**11.8 ft.**
Height	**4.6 ft.**
Wing Area	**42.4 sq. ft.**
Empty Weight	**215 lbs.**
Gross Weight	**375 lbs.**
Max Speed	**79 kts.**
Cruise Speed	**55 kts.**
Stall Speed (clean)	**30 kts.**
Aspect ratio	**9.43**
Rate of Climb	**545 ft./min.**
CG Position	**29-32% Chord**
Payload weight	**~100lbs**
Payload power	**28V DC**
Duration	**8-10 hrs**

Swift Engineering has SBIR Phase II funding to flight test a 30-day vehicle with 15lb payload at Yuma in Summer 2019 at Yuma Proving Grounds. ASP supports a Technical Monitor to the project and is providing a test payload to validate platform capabilities.

NASA SBIR PII – HALE UAV update

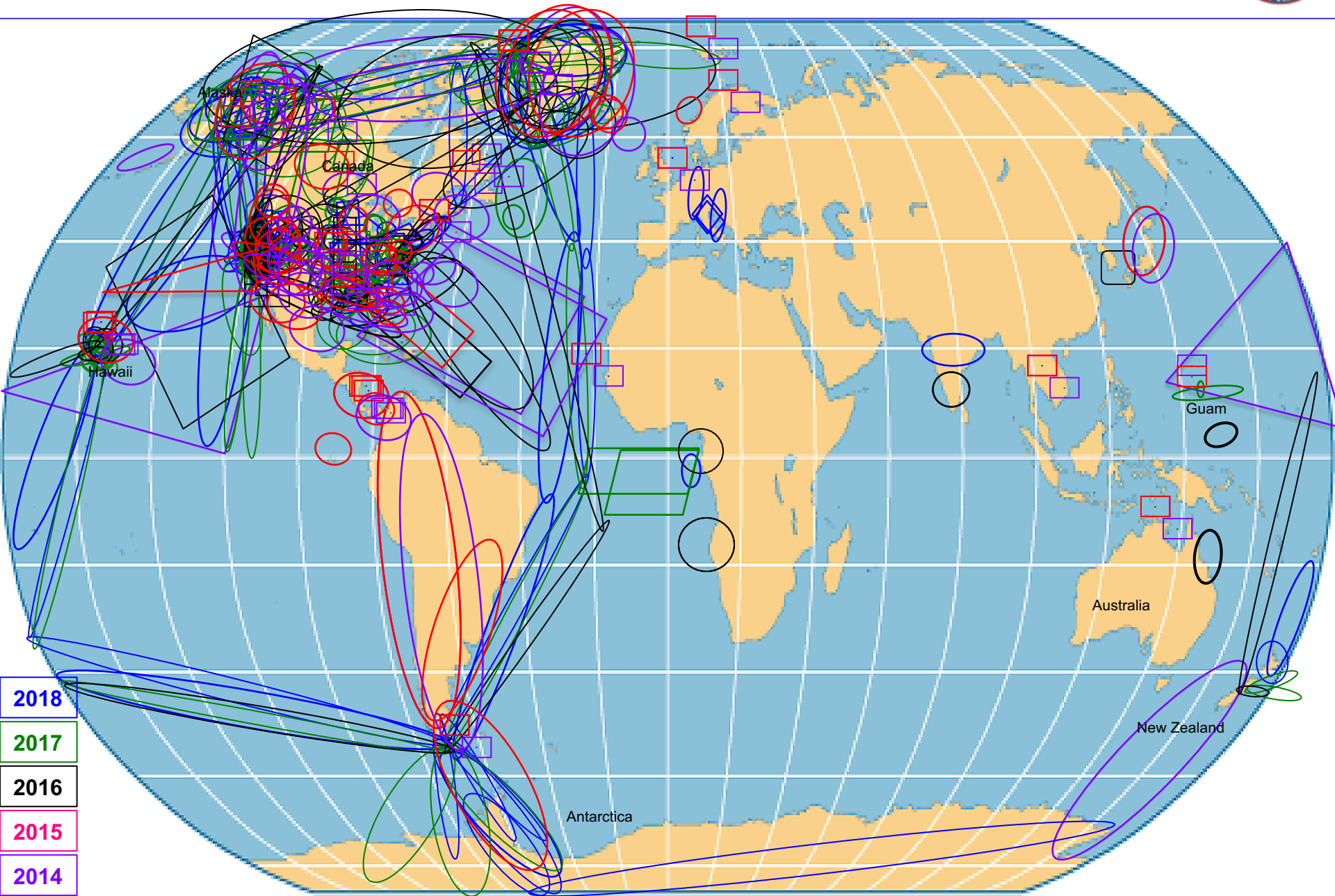
- NASA has been leading the development and science rationale for this new type of aircraft for 2 decades.
- Solar electric platform flying at 70kft for weeks to months with smaller payloads
- Provides observations similar to geostationary satellites; cubesat testbed
- Airbus Zephyr, Aeroenvironment+Softbank, Aurora Odysseus, and Prismatic are commercial programs in development
- NASA is funding Swift Engineering to test a prototype aircraft in summer 2019.
- Costa Rica is one location that is being investigated to support flight testing



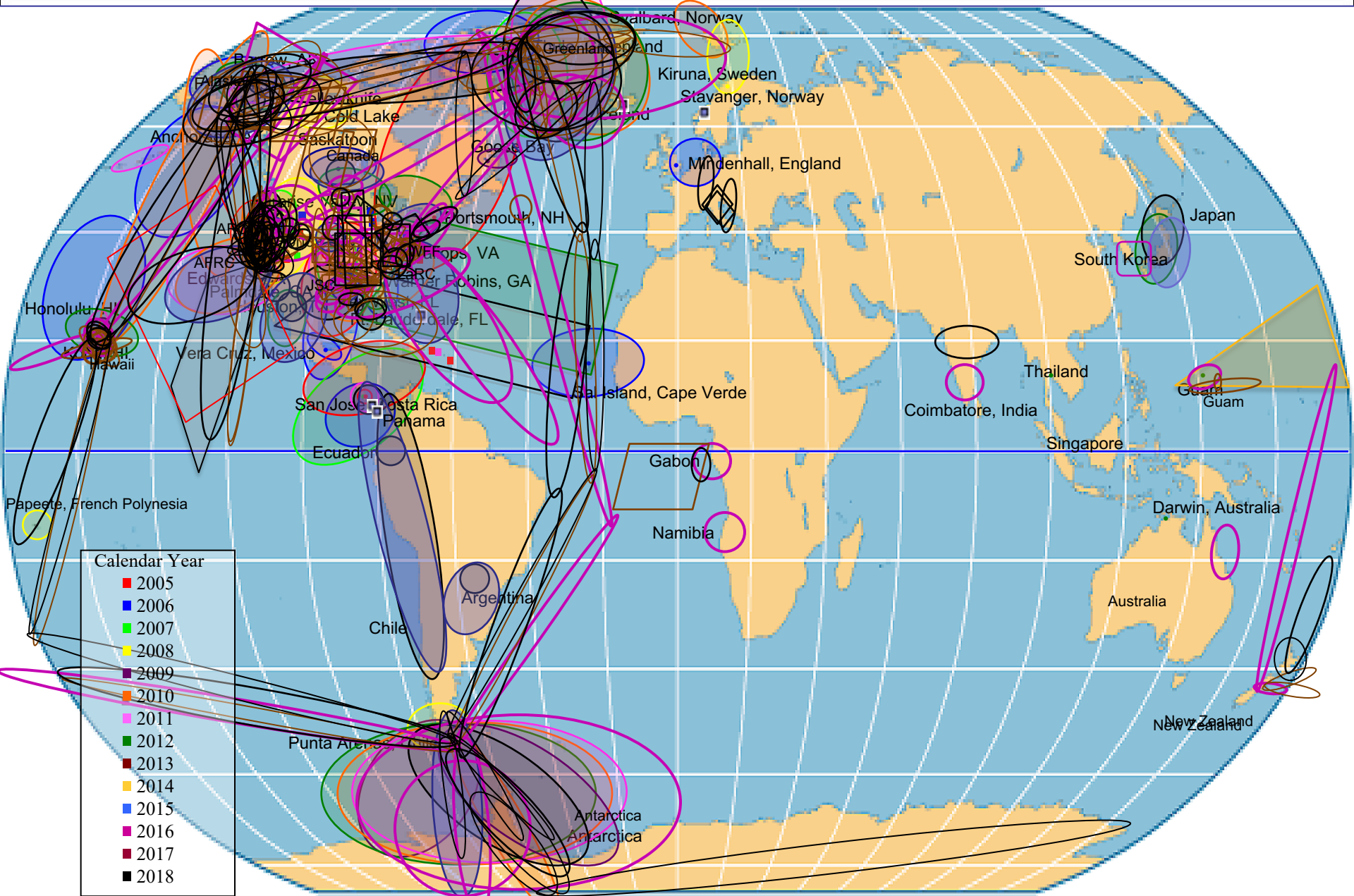


- 30-day @ 70k ft
- 15lb payload in nose
- LiS battery

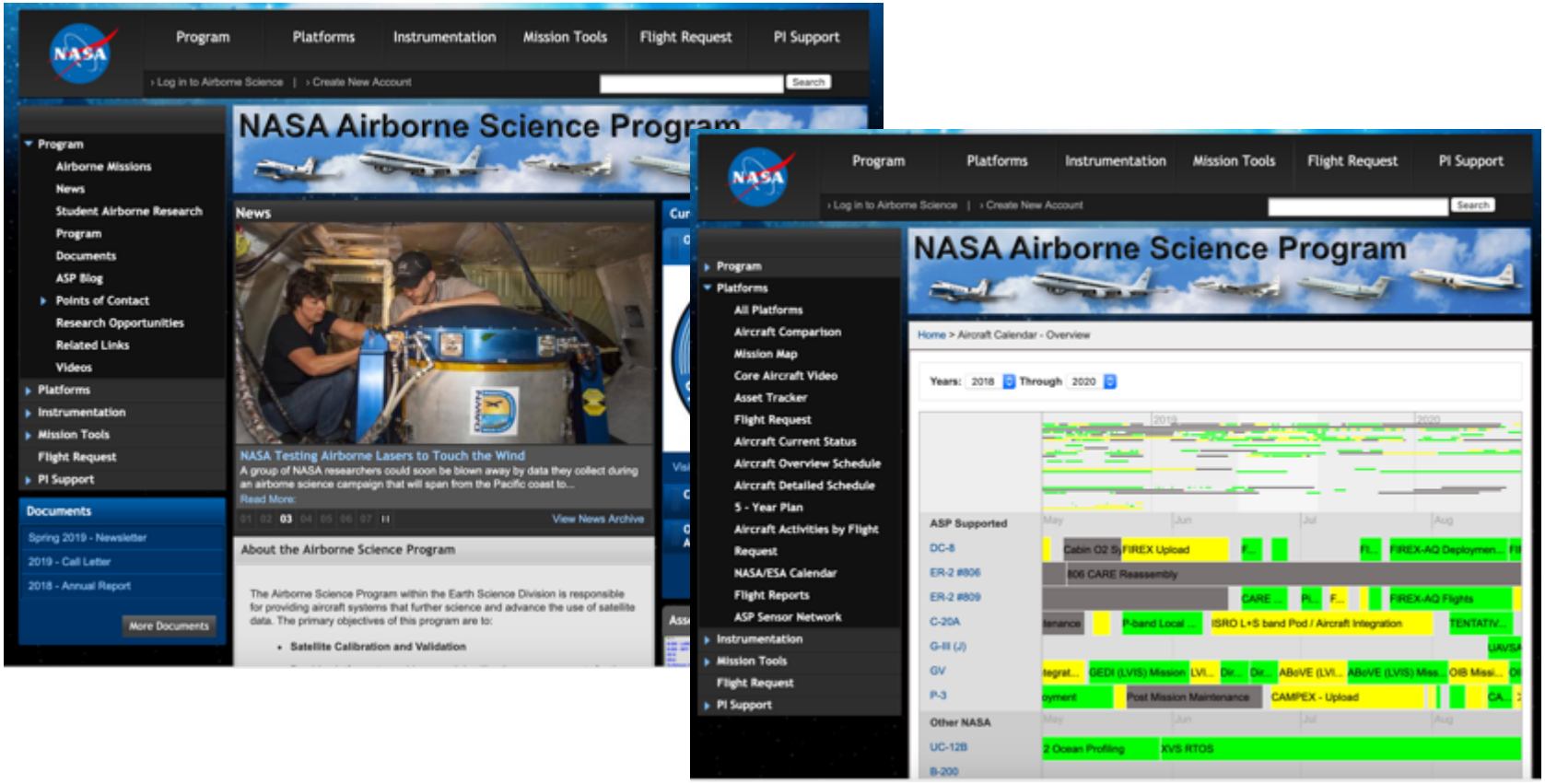
ASP Airborne Campaigns 2014-2018



2005-2018 Airborne Campaigns



Airborne Science Program Online Resources

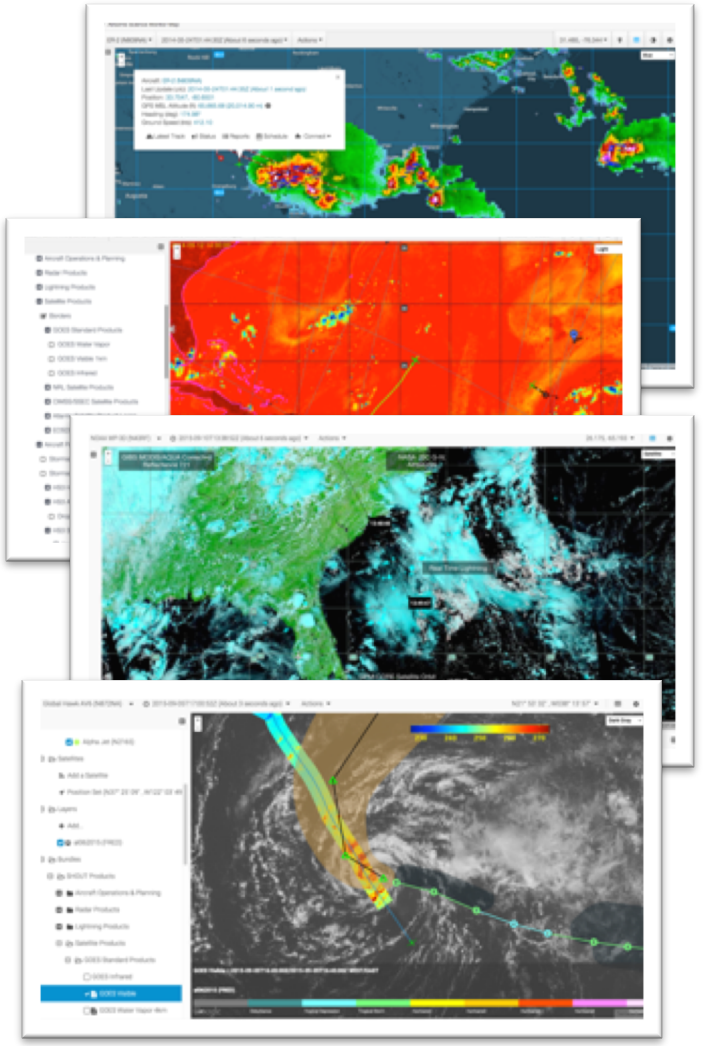


- Airborne Science asset details and schedules are available online at:
  - https://airbornescience.nasa.gov

- Aircraft cost estimates and flight hours can be requested using the online flight request system:
  - https://airbornescience.nasa.gov/sofrs/

MISSION TOOLS SUITE (MTS)

- Tactical decision-making and distributed team situational awareness
- Real time position and instrument telemetry ingest and visualization for single- and multi-asset campaigns
- Access to low latency satellite, radar, global lightning and other meteorological and mission products
- Communication and collaboration tools including document sharing and turn-key chat solutions
- Satellite pass prediction and swath visualization
- Mission operation and planning tools



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For more information visit: https://mts.nasa.gov

6- Month Flight Schedule for SMD missions