



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# AIRBORNE SCIENCE PROGRAM

2019 PROGRAM PLATFORMS



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

September 12, 2019

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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

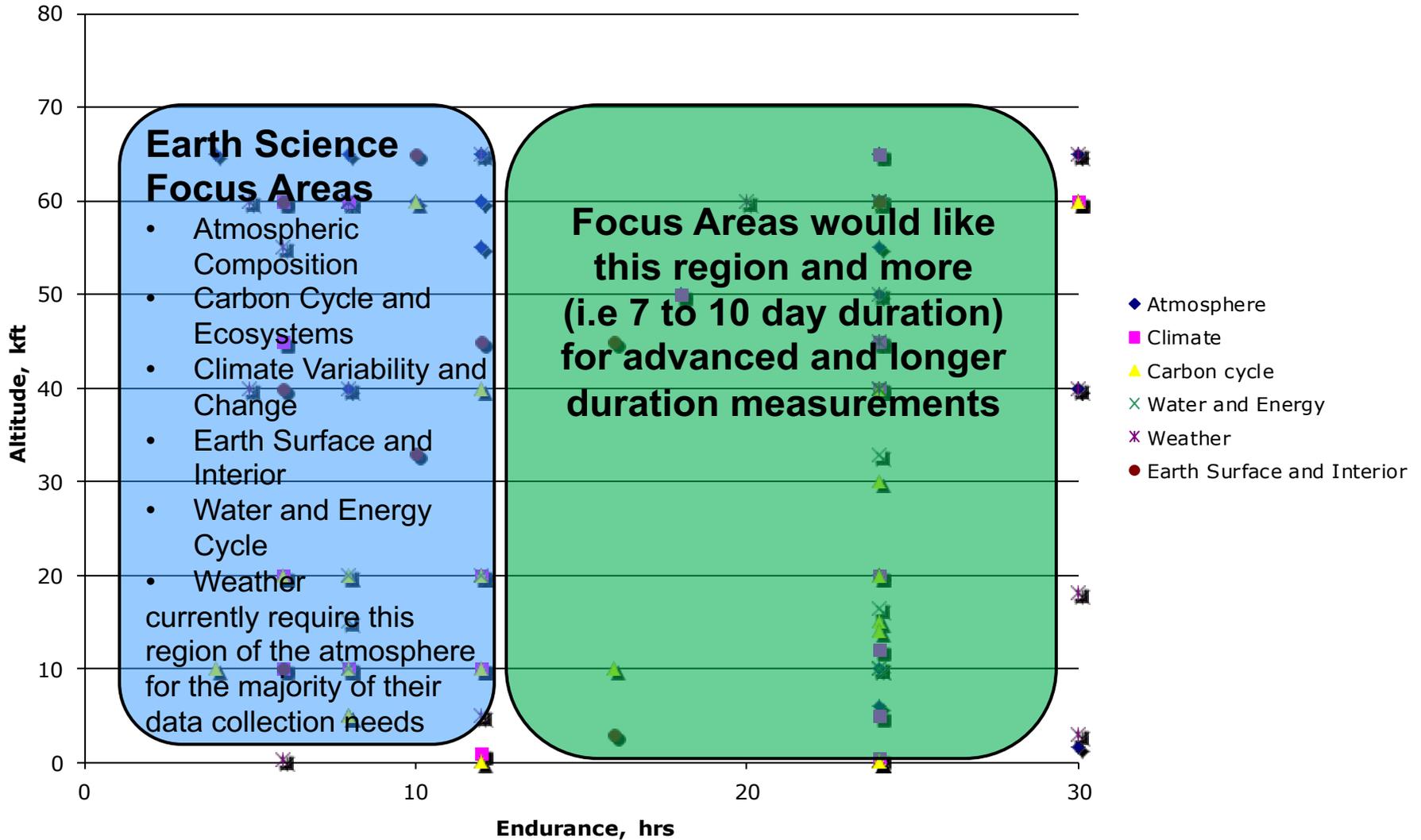


- Provides airborne capability to meet Earth Science requirements utilizing NASA, OGA, and commercial platforms
  - Capability maintained/added/removed based upon budgets and requirements
  - Requirements vetted yearly
  - Actively looking for options
  - <https://airbornescience.nasa.gov/>
- Responsive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

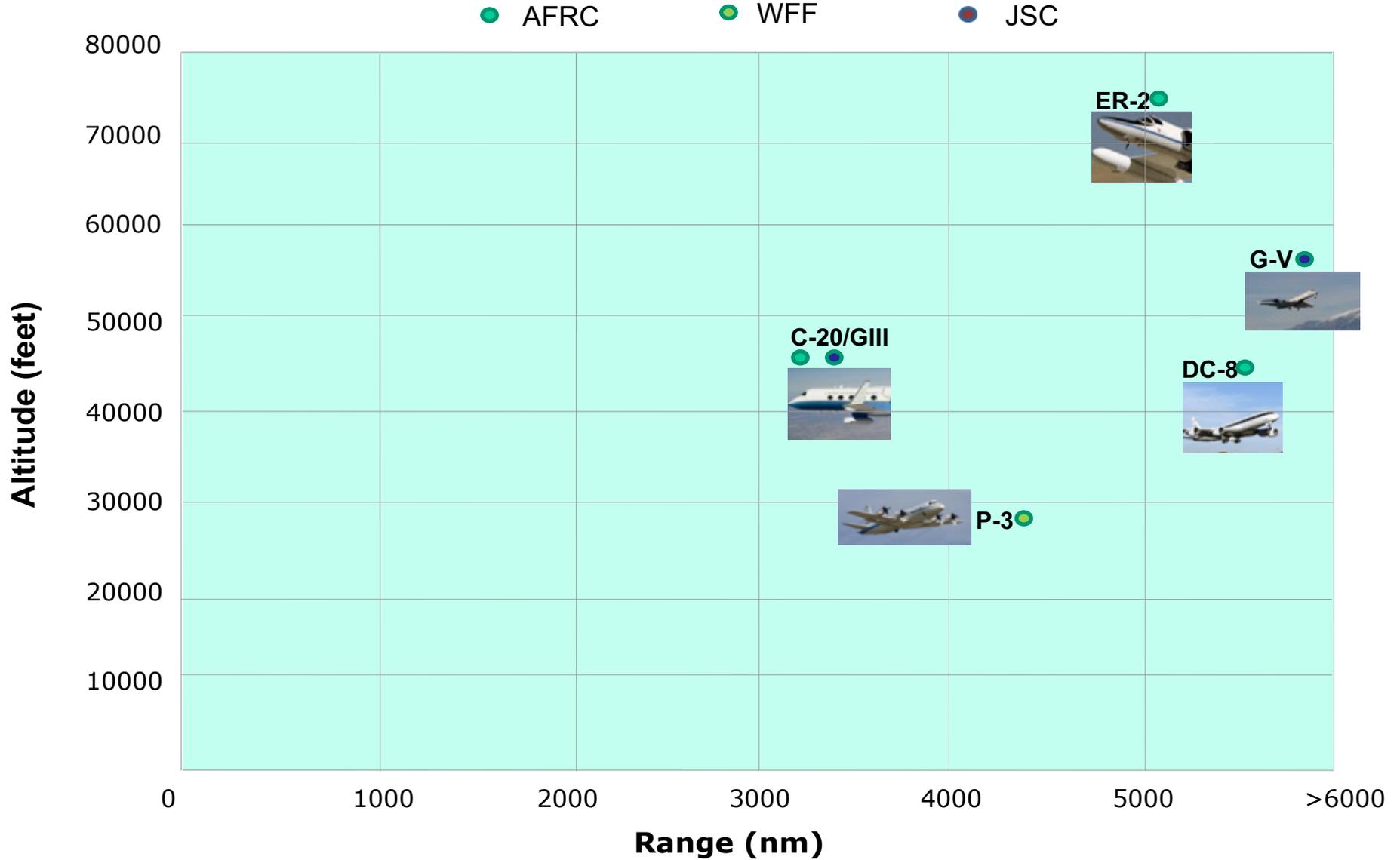


**Bottom Line – cost effective data collection from 500 - 70kft and from 2 - 30 plus hours and beyond (7 to 10 days)**





# NASA ESD Core Funded Aircraft





# Recent Accomplishments

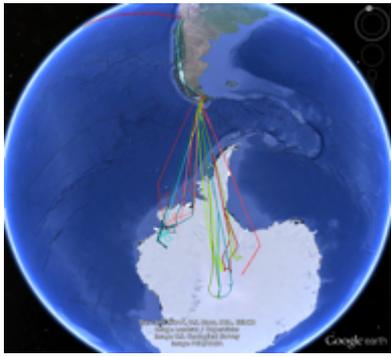
(as of May 2019)



- 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
  - HyspIRI 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



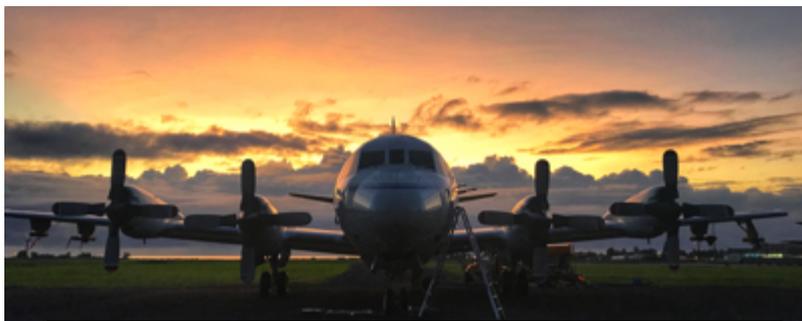
DC-8 Antarctic Flights 2018



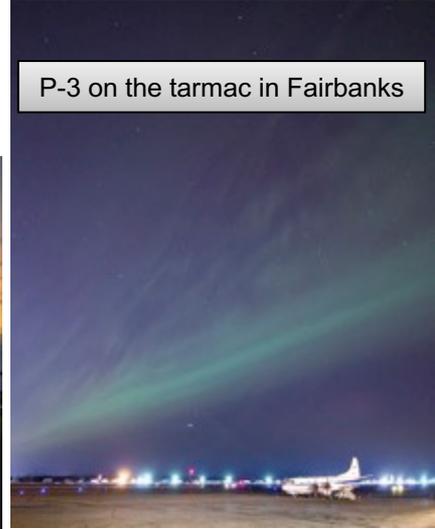
G-V and team in Houston



ER-2 in Hawaii for HyspIRI/HyTES



P-3 in São Tomé for ORACLES



P-3 on the tarmac in Fairbanks

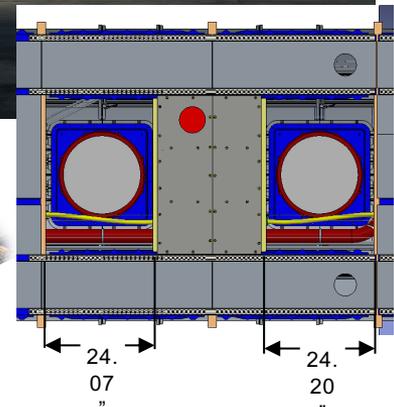
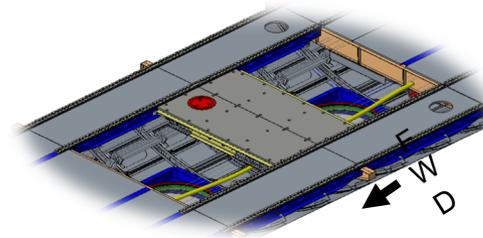


# Gulfstream V (NASA N95NA)



- 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**



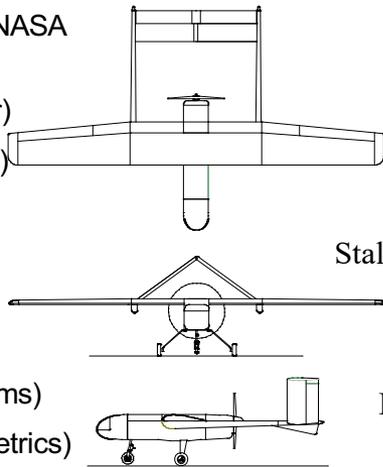
- SIERRA complements other UAVs in the NASA science fleet specializing in dangerous, low altitude missions that require larger payload capacity than typical small UAVs

- 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/H2O (Los Gatos Research/Picarro)
- C-Band SAR (Artemis/BYU)
- UHF/L-band SAR (Mirage Systems)
- Flux-gate Magnetometer (Geometrics)



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

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



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



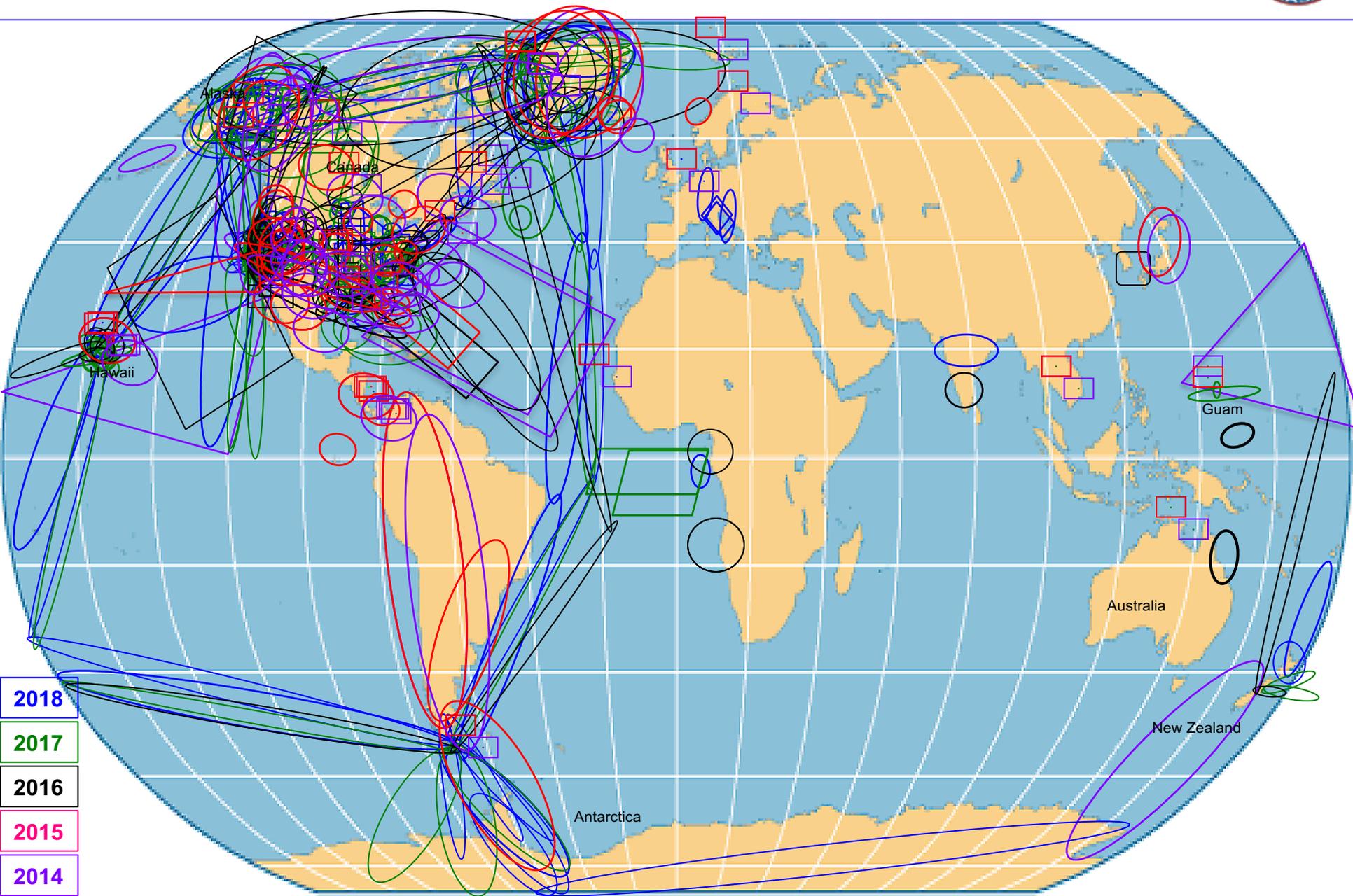
- NASA has been leading the development and science rationale for this new type of aircraft for 2 decades.
- Solar electric platform flying at 70kft for weeks to months with smaller payloads
- Provides observations similar to geostationary satellites; cubesat testbed
- Airbus Zephyr, Aeroenvironment+Softbank, 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



2018

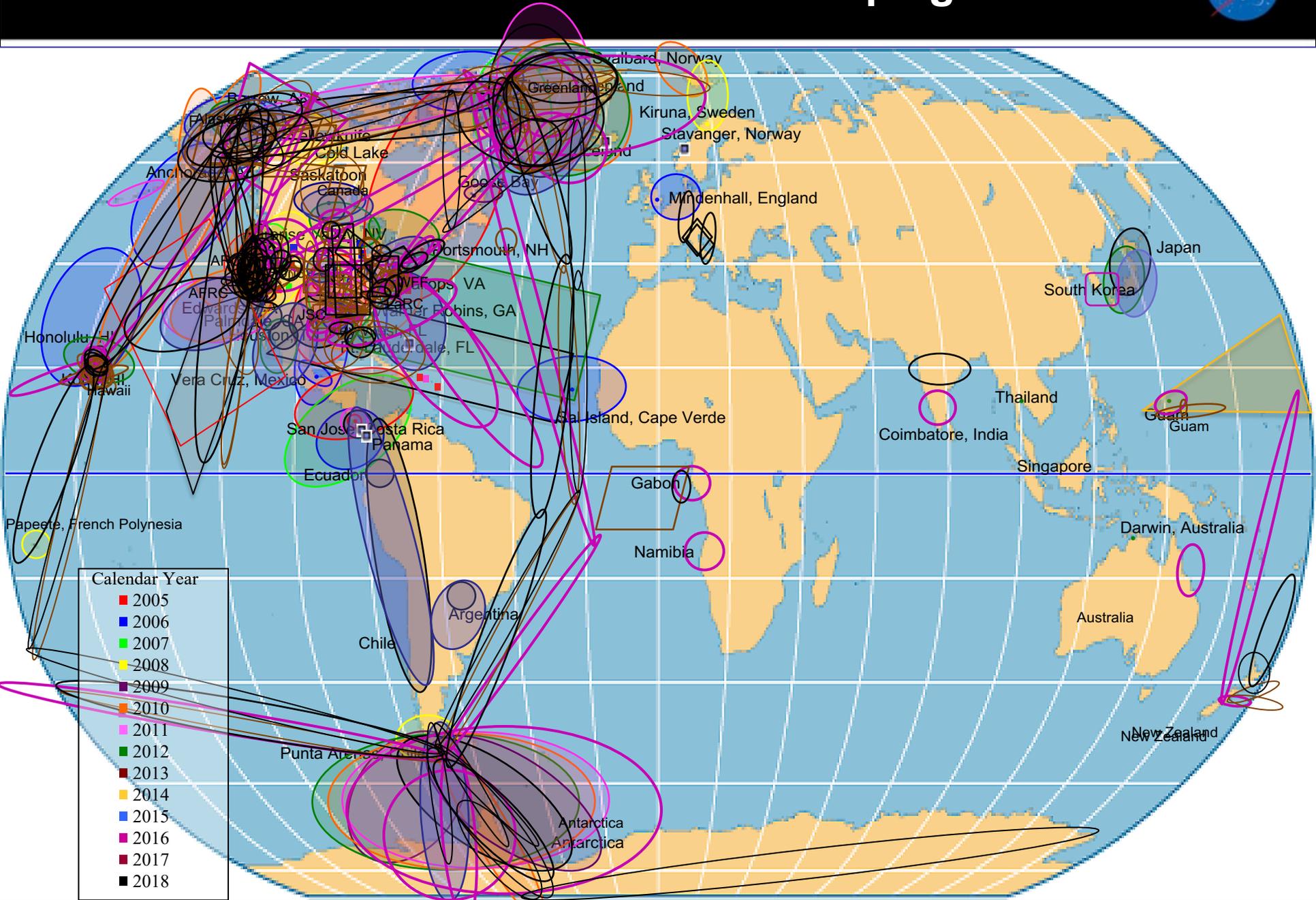
2017

2016

2015

2014

# 2005-2018 Airborne Campaigns



- Calendar Year
- 2005
  - 2006
  - 2007
  - 2008
  - 2009
  - 2010
  - 2011
  - 2012
  - 2013
  - 2014
  - 2015
  - 2016
  - 2017
  - 2018



# Airborne Science Program Online Resources



The screenshot displays the NASA Airborne Science Program website. The top navigation bar includes links for Program, Platforms, Instrumentation, Mission Tools, Flight Request, and PI Support. A search bar is located on the right. The main content area features a news article titled "NASA Testing Airborne Lasers to Touch the Wind" with a photo of researchers in a cockpit. A sidebar on the left lists various program resources. A central menu provides access to platform details and flight request systems. On the right, an "Aircraft Calendar - Overview" shows a Gantt-style chart of flight schedules for various aircraft from 2018 to 2020.

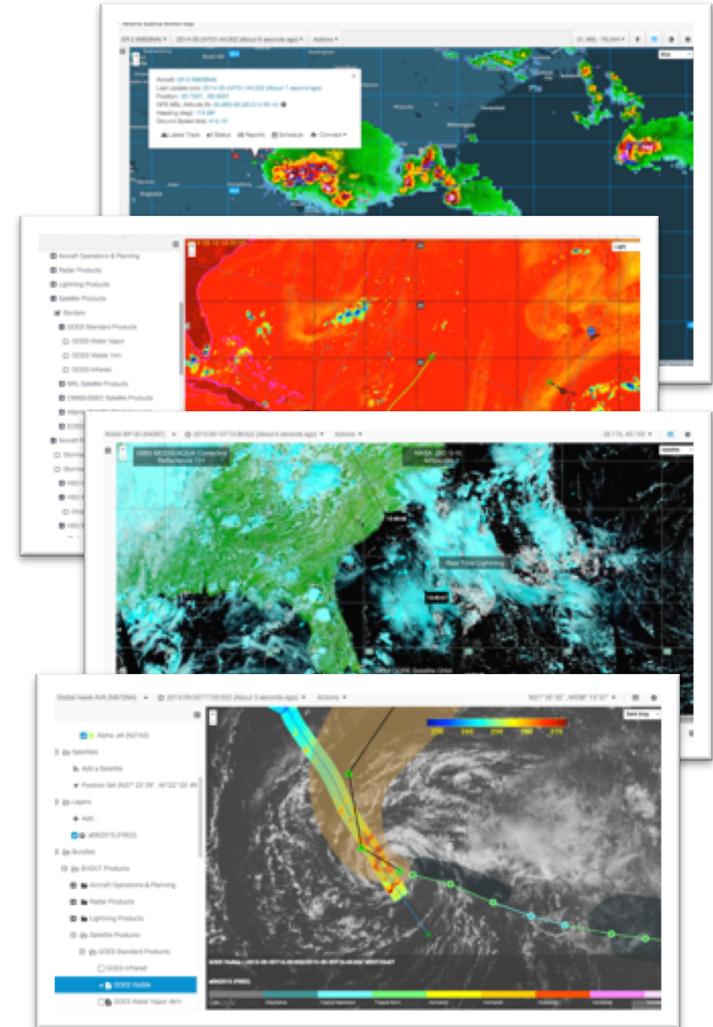
- Airborne Science asset details and schedules are available online at:
  - <https://airbornescience.nasa.gov>
- Aircraft cost estimates and flight hours can be requested using the online flight request system:
  - <https://airbornescience.nasa.gov/sofrs/>



# 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



Project Lead: Aaron R. Duley, Ph.D.  
NASA Airborne Science Program  
Ames Research Center, Moffett Field, CA  
For more information visit: <https://mts.nasa.gov>



# 6- Month Flight Schedule for SMD missions



NASA Airborne Science Program 6-Month Schedule starting September 2019 *(generated 9/11/2019)*

FY19	FY20											
Q4	Q1						Q2					
Sep	Oct	Nov		Dec		Jan		Feb				

## ASP Supported Aircraft

DC-8	FIREX	RDO	1A M	RDO	Code	FIREX-AQ Standby Local Flight						DC-8 Heavy Maintenance									
ER-2 #806	806 CARE Reassembly																				
ER-2 #809	Hyspl	Hyspl IRI Flights		Hyspl	Pilot	Roscoe	Roscoe Flig		Pilot	AirLU	Pilot Proficie	IMPACTS U		200 hr Maintenanc		IMPACTS P		IMPACTS Science Flights			
C-20A	Maintenance		ISRO L+S band Pod / Aircraft Integra				ASAR Loca		TENT	ASAR Loca		L-band SNC		Maintenance: Ops 1&2				RDO			RDO
G-III (J)	UAVSAR, A		L-ban	L-ban	L-band NIS		L-ban														
GV	OIB Mission		Direct Return		Direct	OIB M		OIB Mission													
P-3	CAMPEX - Science Flights				CAMF	CAMF		Annual Maintenanc		IMPACTS -		IMPACTS - Upload				IMPA	Pilot	IMPACTS - Science Flights			

## Other NASA Aircraft

UC-12B	IPDA 2019																			
B-200																				
B-200 (A)	RDO	Tiger Shark FT6 Flights						TENT	TENTATIVE - Dop		RDO			RDO			RDO			RDO
B200 (L)	Phase Inspection						ACTIVATE Flight Prep						ACTIVATE							
C-130H #436	C-130 Maintenance and Air Drop Modifications						Funct	Air Dr				Commercial						Commercial		
Sherpa																				
Cessna																				
Cirrus SR22																				
DE																				
C-20B	Base	Upload CMIS				CMIS														
HU-25A #524	ACTIVATE																			
Lear 25																				
S-3B																				