National Aeronautics and Space Administration

EXPLORE AIRBORNE SCIENCE NEWSLETTER

SPRING 2023

Directors Corner

Thanks for taking the time to catch up on all the activities happening in the NASA Earth Science Division Airborne Science Program.

Perhaps the biggest news in this Spring 2023 edition of our newsletter is the addition of a Boeing 777 to our science fleet. After several years of studies, including one from the National Academies of Science, we were given approval (and the budget) to make this major acquisition to replace the storied DC-8 flying laboratory. A team of our best engineers, led by Martin Nowicki and Tyler Thompson, has been formed from across the agency and we are working on the modifications required to bring the aircraft into service for Science by FY2025.

Also in this issue, you will find updates from several Earth Venture Suborbital-3 missions that are conducting their final year of flights: IMPACTS and S-MODE. The NASA Earth Science Division is also celebrating two recent successful satellite launches, with TEMPO and SWOT now on orbit – and that means it's time to start underflying them for calibration and algorithm validation. In fact, SWOT cal/val is underway using our GV aircraft, and has been coordinating with S-MODE in the Pacific off the Monterey coast.

We would also like to acknowledge Brenna Biggs' excellent contribution to SARP the past few years. Ryan Bennett (ARC) is taking over the Project

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What's Inside

SCIENCE HIGHLIGHTS

Flight tracks for the Winter 2023 deployment of IMPACTS. The P-3 was based at WFF and the ER-2 was based at Dobbins ARB. Visualization provided by Mission Tools Suite (MTS).

IMPACTS Completes Final Deployment

Submitted by Brenna Biggs and Vidal Salazar

The Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS) campaign wrapped up its third and final year this Winter 2023. IMPACTS was an EVS-3 investigation managed by ESPO that focused on monitoring snowstorms, specifically snowband formation and movement, instability within the storm, and snow particle physics. *https://espo.nasa.gov/impacts/*

More specifically, IMPACTS aimed to determine how multi-scale dynamical and microphysical processes within winter storms

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IMPACTS Completes Final Deployment

PI Lynn McMurdie in front of the ER-2 ready for deployment in IMPACTS. Photo credit: Lynn McMurdie

interact to produce banded regions of organized snowfall (i.e., "snowbands"). The objectives are summarized below:

- Determine the key structures and key spatial and temporal scales of banded structures within mid-latitude winter storms.
- Examine the dynamical processes associated with bands and generating cells, as diagnosed from in-situ and Doppler-derived wind fields and vertical motions.
- Determine the microphysical processes and characteristics within and surrounding the banded structures and how they relate to snowfall reaching the surface and remote sensing of snow.
- Use observations in conjunction with models to improve under standing of snow bands, identify deficiencies in model micro physical parameterizations, and improve these parameterizations.

IMPACTS combined advanced radar, lidar, and microwave radiometer remote sensing instruments (HIWRAP, EXRAD, COSMIR, CRS, AMPR, and CPL) on the AFRC ER-2 with state-of-the-art microphysics probes and dropsonde capabilities (AVAPS, TAMMS, WISPER, Hawkeye, and wing probes) on the P-3 to sample United States East Coast winter storms. The aircraft commonly flew in a stacked formation to capture vertical information about snowstorms. While flights were typically localized around the northeastern United States, the aircraft flew as far west as Minnesota, as far north as Canada.

During the Winter 2023 deployment, the P-3 flew 118.2 hours, including 13 science flights and 5 calibration flights, and the ER-2 flew for 103.7 hours, including 12 science flights and 2 calibration flights. Ten of the science flights were coordinated between the two aircraft and two flights were coordinated with ground assets as well.

This concludes the IMPACTS campaign, which also deployed in 2020 and 2022. In total, the ER-2 and P-3 flew 240.6 hours and 272.3 hours, respectively, for the campaign. The massive amount of data collected will help better understand and predict snowstorms by supporting weather (and additional) satellites including GOES R, CloudSat, and GPM.

The Wallops team attends an early pre-flight briefing aboard the P-3 prior to today's science flight. Photo credit: Vidal Salazar

Westminster High School students interview IMPACTS Project Manager, Vidal Salazar, inside the P-3 aircraft. Photo credit: Westminster High School

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Leadership Corner (cont.)

leadership for SARP and Brenna is now supporting the Ames Airborne Science Program Office with communications and planning.

We also recently completed an independent assessment of the Program and would like to thank those of you in the community who supported that survey effort. While we continue to refine our services, there is always room for improvement and this analysis helps us to focus on specific improvements. If you have any feedback on how the Program is serving NASA Earth Science, please don't hesitate to reach out to me or my Deputy Derek Rutovic. Thanks for your interest and support for NASA Earth Science from aircraft!

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S-MODE Sets Sail

Submitted by Erin Czech and Brenna Biggs

The Sub-Mesoscale Ocean Dynamics Experiment (S-MODE) entered their second Intensive Observation Period (IOP-2) in early April 2023, continuing through the beginning of May 2023.
https://espo.nasa.gov/s-mode
The mission is occurring offshore of San Francisco, over 100 nautical miles in the Pacific Ocean. S-MODE aims to determine how sub-mesoscale (1 –10 km) ocean dynamics, such as eddies and fronts, make important contributions to vertical exchange of nutrients, heat, and gases in the upper ocean. These small-scale processes likely play an important role in climate change as well as the biology and survival of ocean life. S-MODE is using a combination of in situ and remote sensing equipment to achieve the following goals:

- Measure the 3D structure of the sub-mesoscale features responsible for vertical exchange.
- Quantify the role of air-sea interaction and surface forcing in the dynamics and vertical velocity of sub-mesoscale variability.
- Understand the relation between the velocity (and other surface properties) measured by remote sensing at the surface and just below the surface boundary layer.
- Diagnose dynamics of vertical transport processes at sub-mesoscales to mesoscales.

S-MODE uses three aircraft, a research vessel, autonomous in situ instruments, and satellite data in order to achieve these goals. The AFRC B-200 payload contains two instruments: the Doppler Scatterometer (DopplerScatt), which measures ocean vector winds and surface currents to investigate air-sea interaction, and the Multiscale Observing System of the Ocean Surface

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NASA B-200 Aircraft (N801NA) with instrument operators, air crew, and ground crew at NASA Ames. Photo credit: Carrie Worth

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S-MODE Sets Sail

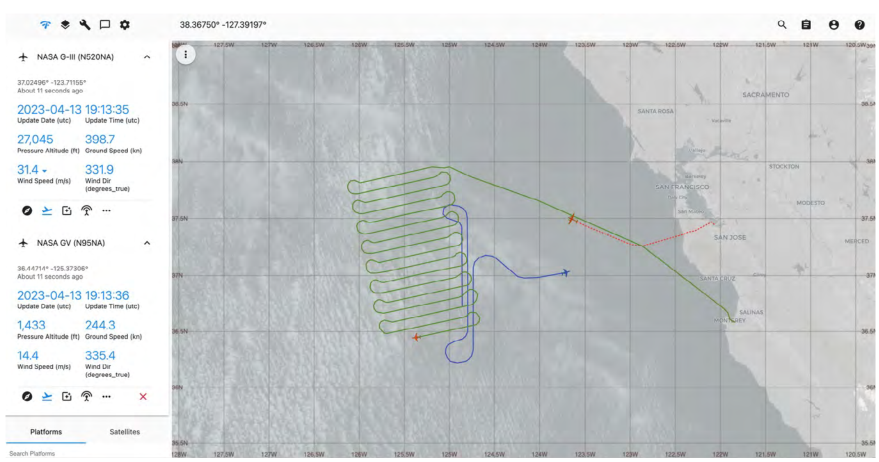
(MOSES), which measures sea surface temperature. S-MODE is also flying the Portable Remote Imaging Spectrometer (PRISM) on the LaRC G-III. PRISM measures radiance, ocean color, and chlorophyll-a (which can imply nutrient levels and phytoplankton concentration). Finally, S-MODE is also flying the Modular Aerial Sensing System (MASS) on a Twin Otter from Twin Otter International, which measures ocean surface and land topography, thermal imagery, hyperspectral imagery, visible imagery, and point temperature.

These flights are complemented by in situ measurements captured onboard the Research Vessel (RV) Sally Ride. One of the most important parts of the vessel payload is the EcoCTD, which is cast from the boat like a fishing pole and sinks nearly 400 feet into the ocean. The EcoCTD provides information regarding the temperature, salinity, pressure, chlorophyll, backscatter, and oxygen in the ocean and can be an important tool in deciding where to collect additional water samples. Additional in situ measurements are collected using autonomous equipment launched from RV Sally Ride. This includes the use of sea surface equipment, like wave gliders and surface drifters, as well as submersibles like gliders and Lagrangian floats.

Finally, S-MODE scientists are comparing their observations with those from the Surface Water Ocean Topography (SWOT) satellite, which was launched late 2022. SWOT is currently doing 1-day repeat crossovers over the S-MODE study area offshore of California, as discussed on page 5. The S-MODE PRISM measurements also have value for PACE and SBG in terms of "ground truthing" ocean surface imaging

NASA Gulfstream III Aircraft (N520NA) at NASA Ames with Participation from the NBC Today Show, Instrument on board: PRISM. Photo credit: Jacob Soboroff (NBC) using an autotimer on his personal cellphone

The RV Sally Ride Science Party with NASA HQ Program Manager Nadya Vinogradova-Shiffer in San Diego prior to the commencement of the S-MODE IOP-2 research cruise. Photo credit: Erin Czech



NASA Mission Tools Suite on April 13, 2023 showing the AFRC B200 (red track), the LaRC G-III (blue track), and the JSC GV (green track). The GV is shown flying a cal/val mission for the SWOT satellite, while the B200 and the G-III were flying for S-MODE.

NASA GV flies SWOT cal/val Mission

Contributed by Luc Lenain and Brenna Biggs

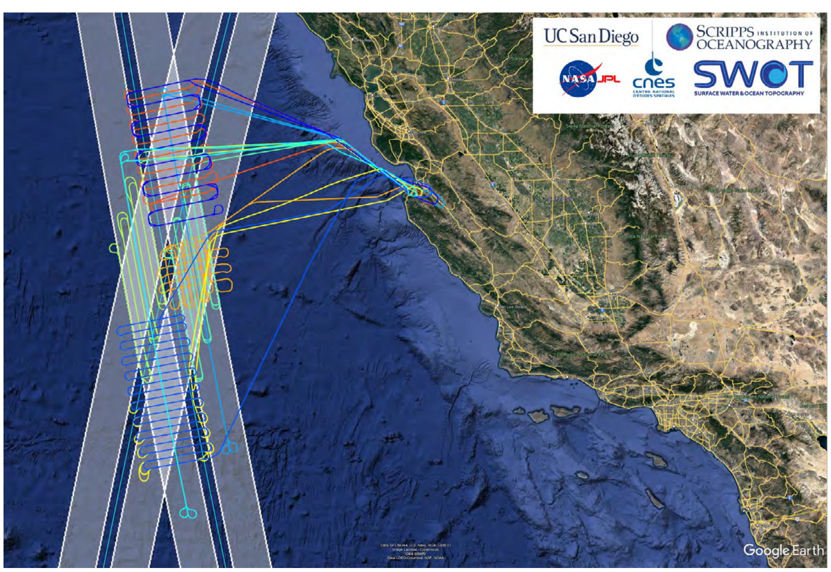
The JSC Gulfstream-V (GV) has been busy collecting data off the Western coast of the United States during early 2023. The aircraft flew 13 flights between March 27 and April 14, 2023 for a total of 65 flight hours. X These flights were conducted in support of the SWOT satellite mission. SWOT was jointly developed by NASA and Centre National D'Etudes Spatiales (CNES) and was launched on Friday, December 16. With the high-definition data collected from this satellite, we can observe almost all bodies of water on Earth's surface – including sources like lakes, rivers, and reservoirs, as well oceans. SWOT contains an instrument nicknamed "KaRIn" – the Ka-band radar interferometer. KaRIn can measure the height of water by bouncing radar pulses off the water's surface. The signals return to the satellite and are received using two antennas on either side, allowing researchers to measure the height of the water across two separate 30-mile swaths at a time.

GV parked at Monterey, California, airport for SWOT cal/val mission. Photo credit: Nicholas Statom

For the past few months, SWOT has been completing 1-day repeated crossovers of the Pacific Ocean west of California – the same region as the GV flights. The satellite is providing unprecedented data about how the oceans influence – and are influenced by – climate change. Additionally, the satellite will also provide insight about how to prepare climate-resilient cities worldwide, protecting the populated regions of the plant from future floods and other disasters.

The GV, instrumented with the Modular Aerial Sensing System (MASS), an instrument developed at Scripps Institution of Oceanography, flew repeated grid patters off the California coast to collect observations within the footprint of SWOT. In addition to a optical system suite, MASS uses a waveform scanning lidar that makes spatiotemporal measurements of the sea surface similar to the payload ("KaRIn") that SWOT has on board. This enables calibration and validation of the satellite observations.

The SWOT satellite cal/val period occurs in the same region and at the same time as the S-MODE program asprogram, as described on page 4.



GV science flight tracks underly the SWOT observation swaths for SWOT cal/val. Image credit: NASA

Mauna Loa 2022 Eruption **NASA Airborne Topography Change Response**

Contributed by Yunling Lou

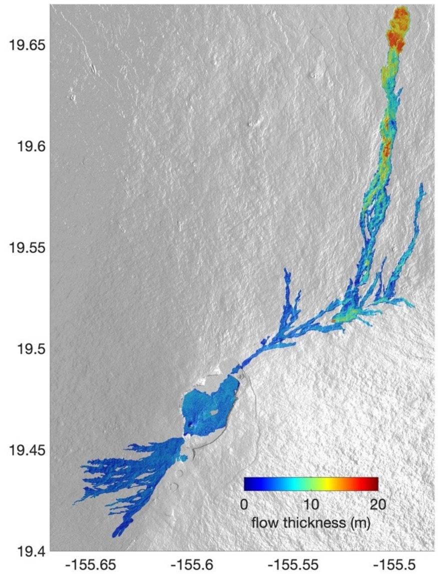
JPL instrument team and AFRC flight crew based at Kona Airport. Photo credit: JPL

On November 27, 2022 at about 11:30PM Hawaii Standard Time, Hawaii's Mauna Loa volcano began to erupt, the first eruption some 38 years since its previous eruption in 1984. During the latest eruption, magma moved into the northeast rift zone with fissure eruptions and lava flows following the topographic gradient to the north in the direction of the Saddle Road connecting Hilo and the Kona coast. UAVSAR was tasked to image the Mauna Loa volcano topography change a few days later as lava flows could potentially threaten the populations and infrastructure where they intersect.

The radar team was deployed to Kona aboard the AFRC Gulfstream C-20A jet on December 6-11, 2022. Radar observations were made on December 7, 8, and 10 using the GLISTIN-A configuration (Ka-band topographic synthetic aperture radar) together with SAR Fusion (a visible and short wave Infrared camera system) to monitor the progression of the lava flows.

Radar data acquired on the first day was rapidly processed into digital elevation models (DEMs) and delivered to the USGS Hawaii Volcano Observatory (HVO) team, who was able to compare the GLISTIN-A DEM to their baseline DEM from 2005 to quickly determine the change in lava thickness and lava volume for eruption response (see Figure). The HVO team then updated their lava flow forecasting models and eruption rates in support of Civil Defense, Hawaii emergency management agency to prepare for the potential of the lava flow reaching and burying the highway between Kona and Hilo. Fortunately, the eruption rates slowed significantly by the second day of our deployment and the highway was no longer in threat.

Lava flow as seen from the jet. Photo credit: JPL



Mauna Loa lava thickness on December 7 compared to pre-eruption DEM acquired by TanDEM-X satellite SAR. Image credit: JPL

Vanilla UAS to Greenland - **CRYOUAS**

Contributed by Brooke Medley

The CRYOUAS team, including Platform Aerospace and GSFC personnel, recently returned from Greenland where they demonstrated science from the Vanilla UAS flying out of Pituffik Space Base near Thule AFB. The UAS carried the University of Kansas CReSIS (Center for Remote Sensing of Ice Sheets) snow radar, which was flown routinely in Greenland for Operation IceBridge. This is the first campaign for the snow radar on the Vanilla long endurance UAS. The snow radar can discriminate snow thickness over glacier ice to determine the topography of the underlying glacier surface. The Vanilla UAS, and other medium altitude, long endurance platforms are well suited for sustained arctic observations in support of IceSAT-2 and other crvospheric science observations.

The team had hoped for more, but were able to fly on two dates. Beyond that, the weather was a barrier. The first flight on April 18 was 2.8 hours in duration, testing all systems and communications. No issues were reported, and some science data were collected nearby as well. On Thursday April 24, the team was at the airfield for an 8:00 am launch. Vanilla did not take off until 1:47 pm local after a series of setbacks due to local air traffic as well as mechanical and technical issues that the Platform Aerospace team had to troubleshoot before takeoff. The goal was to fly for 24 or more hours, but Vanilla encountered several challenges that ultimately had them return to base just shy of 13 hours. The satcom worked well initially, but as Vanilla set out on the science flight, satcom degraded to the point where they returned to line-of-sight communications at Pituffik. The team surveyed snow in the near area while trying to troubleshoot the satcom. Just past 12 hours in, Vanilla's engine temperatures began to rise, and the aircraft struggled to maintain altitude, so they returned to base on April 25 at 2:47 am due to icing concerns. The skies were clear the following Monday and Tuesday, but the winds once more exceeded the Vanilla threshold for takeoff, so no flight was attempted. The team returned to the U.S. on May 5.

View of the Chamberlin Glacier from the tail camera of the Vanilla aircraft. Photo credit: Platform Aerospace

PEOPLE of Airborne Science

Pat Finch shows real dedication and Impact for IMPACTS

Contributed by Matt Fladeland

ASP projects excel with support from our skilled and dedicated team of engineers and specialists. Scientists on flight projects need network access to their payloads in order to check sensor health and data quality. During flight this happens through the Iridium constellation which requires ground-based modems. A great example of ASP dedication to mission was Pat Finch's exceptional support for IMPACTS. On January 10th Ames Research Center, where the Iridium modem array is located,

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Pat Finch shows real dedication and Impact for IMPACTS

had a power outage related to flooding and winds from a winter storm. Pat was informed at 3AM that the network was down and required a manual system restart. As scientists were ready getting ready to fly that day on the P-3 from Wallops, Pat drove to NASA Ames and fixed the problem, thus enabling that day's flight to have real-time data and situational awareness. The IMPACTS science team and program appreciate the dedication of our staff to enable safe and successful science flights.

Patrick Finch, Senior Software Endineer, ARC/BAERI. Captured in a selfie while supporting a mission aboard the NASA DC-8.

Ryan Bennett Becomes NASA SARP Program Manager

Contributed by Brenna Biggs

NASA ASP welcomes Ryan Bennett as the new Program Manager for the NASA Student Airborne Research Program (SARP)! SARP is an eight-week summer internship program for rising senior undergraduate students to acquire hands-on research experience in all aspects of a scientific campaign using one or more NASA Airborne Science Program flying science laboratories (e.g., DC-8, P-3, Sherpa, and ER-2). SARP participants assist in the operation of instruments onboard an aircraft to sample atmospheric chemicals, and/or to image land and water surfaces in multiple spectral bands. Research areas include atmospheric chemistry, air quality, ecology, and ocean biology. Along with airborne data collection, students participate in taking measurements at field sites. The program culminates with formal presentations of research results and conclusions.

Ryan Bennett presents to the SARP 2022 class at AFRC Building 703 prior to flight days. Photo credit: Brenna Biggs

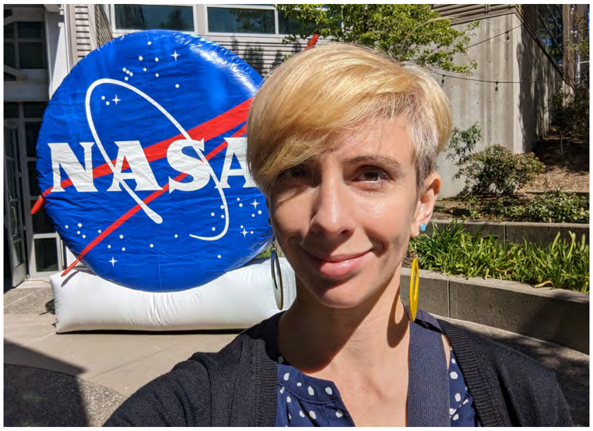
Ryan has an extensive background in Meteorology and has been a part of SARP for several years as Mission Meteorologist as well as an expert in all things data related. He joined the National Suborbital Research Center (NSRC) in 2017 as Data Manager, where he has years of experience quality-checking various iterations of airborne datasets. Ryan interacts with science teams on day-to-day activities providing all the necessary support needed to ensure that the data obtained through NSRC data systems are of high precision and accuracy required for scientific analysis.

Ryan is thriving in his new role as SARP Program Manager; he has recruited students by advertisement, email, and information sessions for SARP 2023, reviewed and selected top applicants from hundreds of SARP applications, and has secured mentors for the leadership team as well as housing for the summer. We look forward to seeing his accomplishments during the program this summer!

Brenna Biggs Joins ASP Advanced Planning Team

Contributed by Brenna Biggs

Brenna Biggs, former Program Manager of the NASA Student Airborne Research Program (SARP), recently joined the ASP Advanced Planning team. Brenna holds a Ph.D. in Chemistry from the University of California, Irvine and has over a decade of science communication experience. In her new role, Brenna works with Matt Fladeland and Susan Schoenung in the ASP strategic planning process. She will assist in creating and maintaining the 5-year plan, drafting ASP Newsletters, compiling and editing materials for the ASP annual report, attending relevant science team meetings and conferences, and tracking ASP science value.



Brenna Biggs visits the Chabot Space and Science Center in Oakland, CA to present to students about NASA S-MODE. Photo credit: Brenna Biggs

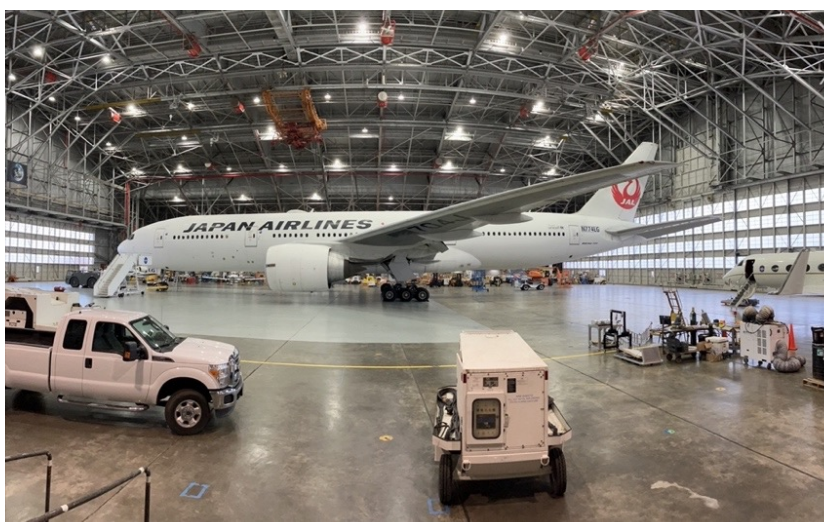
In addition to her new role on the Advanced Planning team, Brenna is also the NASA ASP Science Communications Lead and the NASA ASP-GLOBE Engagement Coordinator. She creates and facilitates outreach events for students in K-12 schools worldwide to highlight ASP campaigns. Most recently, she hosted 20 presentations for 480 students in 9 schools across 4 U.S. states and 3 countries to showcase the work that NASA IMPACTS was doing for their third and final deployment.

Aircraft NEWS

777 - The New Flying Laboratory

Contributed by Derek Rutovic

After many years of discussion, market research, and planning, the ASP has purchased a DC-8 replacement aircraft, a B777-200ER formerly operated by Japan Airlines. The aircraft was flown to LaRC to support the start of research modifications on December 15th, 2022, following over two years of COVID-induced desert preservation. This first flight as a NASA asset, though, is just the beginning of a long journey to ready the aircraft to support science research.



NASA B777 at LaRC for modifications. Photo credit: NASA

The necessary modifications to transform the jet from a passenger hauler to a world-class airborne laboratory is underway and will occur in two phases. The first phase of "in-house" modifications comprise what the ASP routinely completes on all aircraft: research power, network and data, antennas, communication systems, and more. The second phase will consist of the structural portals (e.g., windows, nadir, etc.) that will be completed by an outside vendor. Specifications for the aircraft, compared to the DC-8, are shown in the table on page 10.

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777 - The New Flying Laboratory

DC-8 vs. B777-200ER Performance

Aircraft	Payload Weight (kip)	Fuel Load (%)	Range (NM)	Endurance (hr)	Initial Climb Altitude (FL)
DC-8	50*	100	~5000	11	320
B777-200ER	50	55	5400	11.7	360
	50	100	9000	19	300
	100	85	7400	15.6	300

*Approximate ATom-4- payload weight: instruments, people, cargo, etc.

Planning for the first phase began long before the aircraft was purchased, as the ASP worked with multiple Centers to identify and dedicate an elite team of engineers to complete the "in-house" designs. This unique arrangement is a testament to ASP's continued desire to support a horizontal, cross-Agency mindset for aircraft operations. The team came together for the first time in October 2022, to work through an initial set of design requirements. Work over the next two months concentrated on refining requirements in consultation with the science community and current DC-8 operators, culminating in a Systems Requirements Review just after the New Year. Taking advantage of LaRC's tailorable airworthiness process, the overall modification was broken down into subsystems with a Preliminary and Critical Design Review for each. This permits the paralleling of design and on-aircraft work as the jet can be modified once a subsystem CDR is completed without waiting for one, large CDR at the end. Work to support the second phase of modifications has been ongoing as well. The SOW for portal modifications has been written, and a draft RFP is winding its way through LaRC procurement wickets, with contract award anticipated no later than the end of this August. "In-house" modifications are scheduled to be completed in the first half of 2024, at which time the aircraft will transition to portal modification, heavy maintenance, and full aircraft paint.

Current view inside the 777. Photo credit: NASA

The current schedule is for the aircraft to be ready for science in FY25. A tremendous amount of work has been logged by multiple individuals from across the Agency to get to this point, and much remains to be done. It certainly remains a pleasure to have the chance to work on a project that will set the tone for the ASP for decades to come.

New G-IV Capability at NASA LaRC

Contributed by Bruce Fisher

NASA G-IV. Photo credit: NASA

A Gulfstream IV, acquired by NASA LaRC from the U.S. Navy, is now available for science. The aircraft is a twin turbofan business-class aircraft with a maximum of ten onboard operators. The G-IV aircraft can fly for a maximum of 8 hr with a payload of 5610 lbs. It can reach a maximum altitude of 45,000 ft at an air speed of 459 knots. The aircraft flew in 2022 in support of sounding rocket launches out of Alaska for the NASA Heliophysics Program.

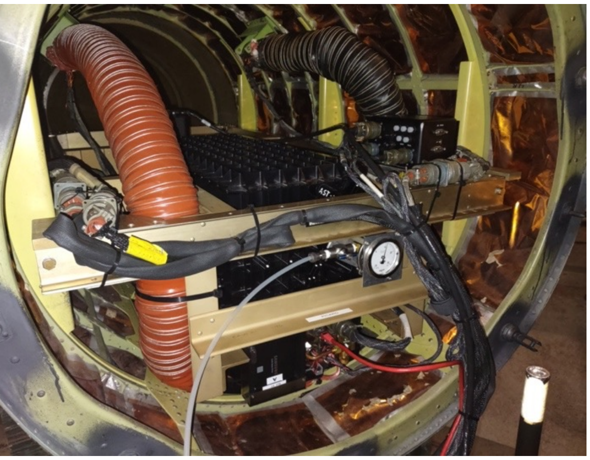
Plans call for the aircraft to be modified in the future to carry the next generation airborne Synthetic Aperture Radar (SAR), which is being developed at the NASA Jet Propulsion Laboratory (JPL) to replace the workhorse UAVSAR instrument/payload package. The G-IV aircraft will be modified to accommodate two radar antennas for simultaneous dual-frequency operation, such as joint P- and L-band SAR operations for ecosystem and land deformation studies. Planned updates include modernizing the SAR radar electronics by implementing a digital beamforming capability. This modification will enable the aircraft to serve as a testbed for future SAR technologies needed to make new measurements, such as surface and vegetation structure, to support future decadal survey themes.

Whereas the new SAR capability is expected to be ready in 2 to 3 years, the aircraft is currently available for Earth Science and Heliophysics missons, including use of the large cargo bay. In addition, plans are being prepared to provide airborne thermal imaging support for vehicle reentries through the Earth's atmosphere. However, no custom nadir or zenith research portals have been installed in this aircraft at this time. The LaRC G-IV team welcomes all inquiries regarding proposed missions for the aircraft.

ASP **Instrumentation & Support**

PICARD Instrument Flies WDTS

Contributed by James Jacobson



PICARD instrument installed in pod. Photo credit: NASA

The Pushbroom Imager for Cloud and Aerosol R&D (PICARD) instrument is an imaging spectrometer with 205 channels in the VIS through SWIR (400-2450 nm). PICARD consists of two Offer spectrometers mounted to a single four-mirror anastigmat telescope, designed to produce a distortion-free 50-degree field of view over cloud scenes from the ER-2 aircraft. It was originally designed to study optical properties of high-altitude clouds and aerosols relevant to the AOS mission. It also has similar characteristics to the AVIRIS instrument, which is relevant to the SBG satellite mission. In the past year the PICARD instrument has undergone engineering exercises that have improved overall system stability and data quality. While working to develop an integration solution for the NASA G-V, Tom Ellis (Lead PICARD Engineer) has led an effort to improve the system incrementally as opportunities arise. One major milestone has been the PICARD science valida-

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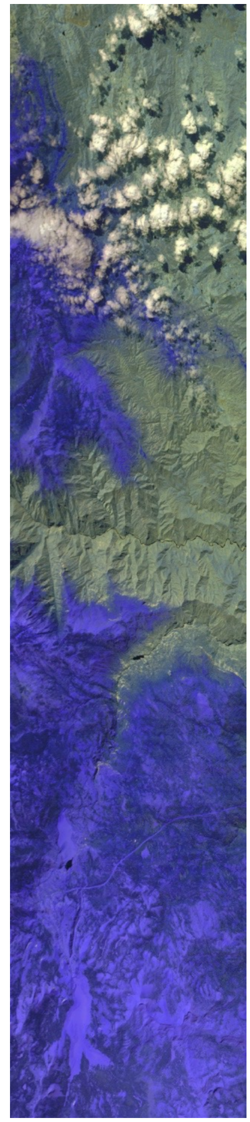
PICARD Instrument Flies WDTS

tion deployment during the Western Diversity Time Series (WDTS) mission of Fall 2022, and again in Spring 2023. While not a prime instrument for this mission, these flight opportunities have facilitated major improvements. This series of flights saw the first success of the newly implemented internal thermal regulation system, which has greatly improved our ability to maintain the calibration of the SWIR camera within PICARD. PICARD was brought back to the Airborne Sensor Facility (ASF) calibration lab for post-mission calibration, after which significant internal modelling work confirmed the orientations of all of the key components of the PICARD Camera systems. This has been instrumental in our efforts to design the PICARD Mark 2 case and has revealed several areas for improvement. In particular, after analyzing the limited mission data from Fall 2022, we realized that PICARD could achieve better signal without saturation over cloud targets by using a neutral density filter replacement window and increasing the integration time. This solution has been deployed for the current science validation flights happening now for WDTS Spring 2023.

PICARD is currently deployed for further validation flights on the ER-2 during the current WDTS/GEMx mission already underway. Our goal is to acquire vicarious calibration targets as well as coincident satellite overpass data to further refine the system, and compare to the other payloads aboard the ER-2 for WDTS. ASF is also looking forward to deploying PICARD for the PACE-PAX mission in Fall 2024.

For more information visit: https://asapdata.arc.nasa.gov/sensors/picard.html



False-color short-wave infrared PICARD image over Yosemite National Park, 31 Mar 2023. Red, green, and blue channels are mapped to the 2.15, 1.55, and 1.15 micrometer wavelength PICARD bands. Snow appears deep blue, clouds appear white, and vegetation appears yellow-green in this image.

AVIRIS-3 Ready for Prime Time

Contributed by Rob Green

The Airborne Visible/Infrared Imaging Spectrometer 3 (AVIRIS-3) is the third of the NASA AVIRIS spectrometer series, following AVIRIS Classic (AVIRIS-C) and AVIRIS Next Generation (AVIRIS-NG). Its core spectrometer is a copy of the optically fast, F/1.8 Dyson imaging spectrometer that is used by Earth Surface Mineral Dust Source Investigation (EMIT), which launched to the International Space Station (ISS) in July 2022.

The AVIRIS series of instruments have been providing calibrated spectral data of the Earth surface since the early 1980's. Applications include numerous science fields (vegetation, geology, oceanography and volcanology), as well as imaging of environmental hazards such as oil spills.

This new spectrometer measures the visible to short wavelength infrared (VSWIR) spectral range from 380 to 2500 nm. AVIRIS-3 is designed for a significantly higher signal-to-noise ratio, a wider swath, and finer spatial sampling compared to AVIRIS-C and AVIRIS-NG. The spectral sampling is matched to that used by EMIT. Imaging spectrometer measurements from AVIRIS-3

are expected to be important for preparatory science and applications research in support of the 2017 Decadal Survey Surface Biology and Geology (SBG)

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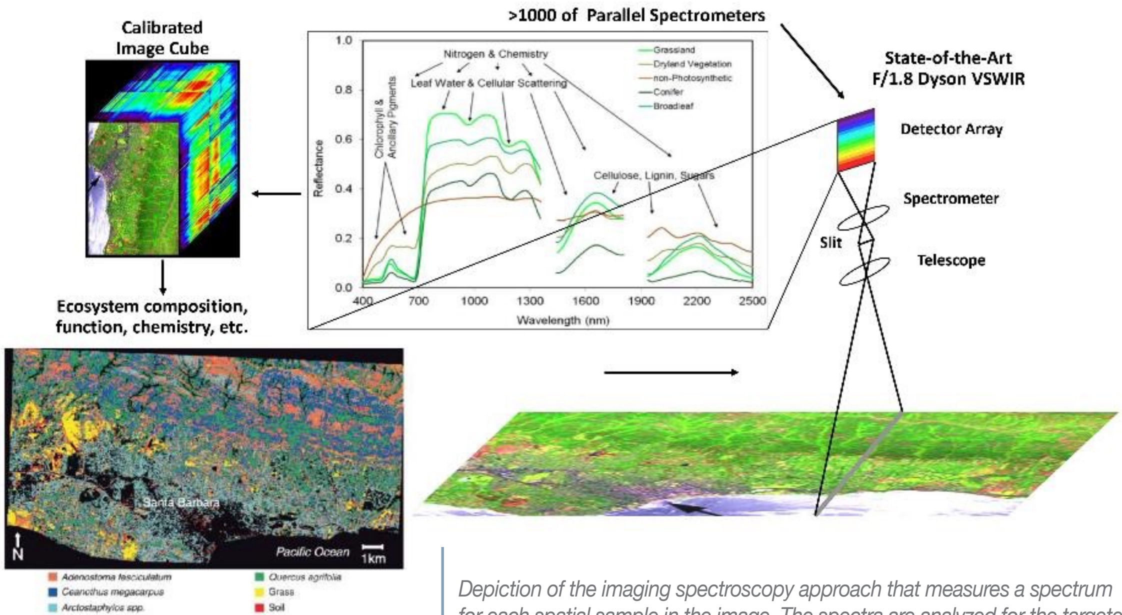
AVIRIS-3 Ready for Prime Time

mission and calibration and validation activities once SBG is in orbit. As with SBG, AVIRIS-3 will be available to contribute to the important objectives of NASA's Earth System Observatory.

The instrument is designed to be adaptable to a range of both unpressurized and pressurized aircraft platforms. AVIRIS-3 is planned to fly this summer on a B-200 and will then be ready for the LaRC G-III and the JSC G-V. AVIRIS-3 is intended to provide NASA with a state-of-the-art imaging spectrometer to support research through the next decade and beyond.



Depiction of the imaging spectroscopy approach that measures a spectrum for each spatial sample in the image. The spectra are analyzed for the targeted science or applications objective (e.g., vegetation species type). Image credit: Rob Green

	AVIRIS-3	AVIRIS-Next Generation	AVIRIS-Classic
SPECTRAL			
Range	380 to 2510 nm	380 to 2510 nm	380 to 2500 nm
Sampling	7.5 nm	5 nm	10 nm
Response (FWHM)	1 to 1.5 X sampling	1 to 1.5 X sampling	1 to 1.5 X sampling
Calibration	+-0.1 nm	+-0.1 nm	+-0.1 nm
RADIOMETRIC			
Range	0 to max Lambertian	0 to max Lambertian	0 to max Lambertian
Precision (SNR)	>3000 @ 600 nm	>2000 @ 600 nm	>1000 @ 600 nm
	>1200 @ 2200 nm	>1000 @ 2200 nm	>400 @ 2200 nm
Calibration	97% (<3% uncertainty)	95% (<5% uncertainty)	90% (<10% uncertainty)
SPATIAL			
Swath samples	1240	600	677
Swath Angle	40° field-of-view	34° field-of-view	34° field-of-view
Sampling	0.6 milliradian	1 milliradian	1 milliradian
Response (FWHM)	1 to 1.5 X sampling	1 to 1.5 X sampling	1 to 1.5 X sampling
Ground Sample (f of alt.)	0.3 m to 20 m	0.3 m to 20 m	4 m to 20 m
Geom Model	Full 3 Axes cosines	Full 3 Axes cosines	Full 3 Axes cosines
UNIFORMITY			
Spectral Cross-Track	>95% across FOV	>95% across FOV	>98% across FOV
Spectral-IFOV-Variation	>95% Spectral Direction	>95% Spectral Direction	>98% Spectral Direction

Table showing overview of the perfomance of AVIRIS-3 compared to AVIRIS-NG and AVIRIS-C.

ASP Iridium Certus® Deployment

Contributed by David Van Gilst

For the last 20 years, baseline ASP telemetry and tracking services have been provided via one or more 2.4 kbps Iridium modems and a bank of dial up modems in a basement at Ames. Soon this era will come to an end, as the last of the multichannel Iridium installations will be replaced with BlueSky's Skylink 7100 'Mid-band' Certus® transceivers. At 22 kbps outbound and 88 kbps inbound, these units will provide several times the bandwidth of existing systems present on most ASP aircraft, with world-wide coverage and significantly improved reliability.

Additional benefits of the upgrade include

- Significantly reduced radio frequency interference in the GPS and GLONASS L1 Bands.
- Reduced reliance on obsolete ground-side infrastructure.
- Addition of high-quality voice telephony services that can be used in parallel with data transmission.
- Improved security through pairing with IPSec VPN technology.

Installation is expected to be completed aboard all ASP-supported aircraft by June of 2023.

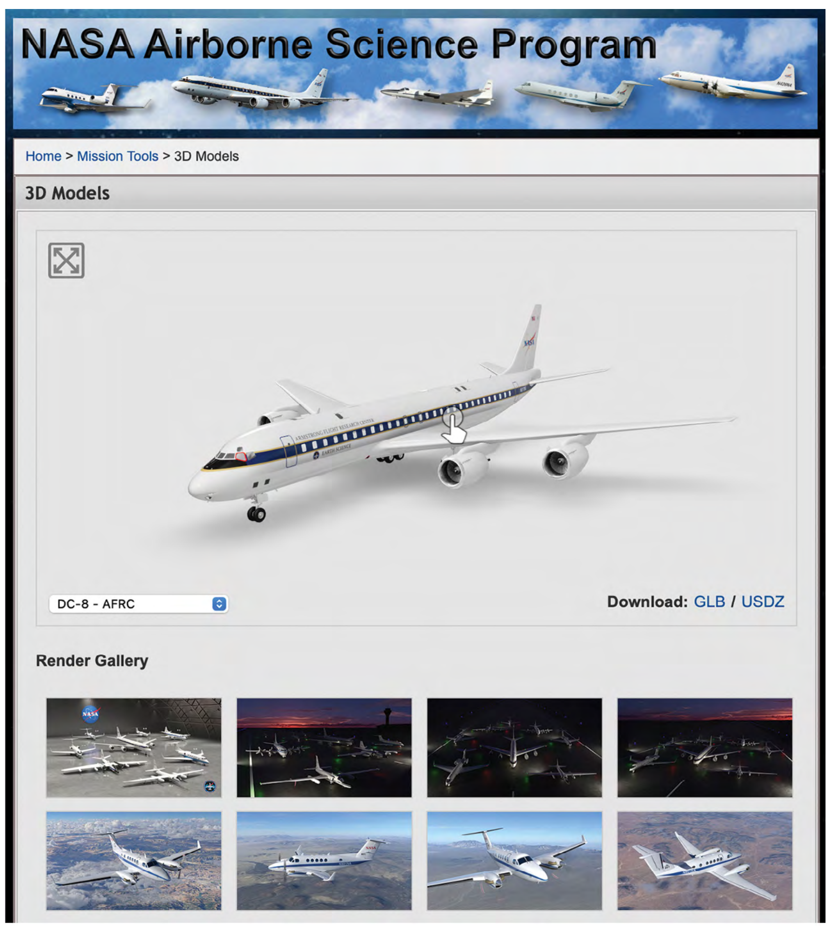
Mission Tool Suite – New Features

Contributed by Aaron Duley

The Mission Tools Suite team recently released a new 3D model viewer available on the NASA Airborne Science website. The new viewer provides an interactive way to explore and visualize our collection of airborne observing platform models. The 3D model viewer is a web-based application that is accessible from any modern web browser. It features an intuitive interface that allows users to easily rotate, zoom, and pan around the 3D models. Our team has also begun to add mission specific models that include payload configurations for platforms supporting multi-year campaigns. Check out the IMPACT's P3 configuration as an example of what's to come.

The 3D model viewer is a valuable tool for educators, students, and anyone interested in learning about Earth science utilizing airborne assets. It allows users to interact with the models in a way that static images or videos cannot provide. We invite you to

(continued on Pg. 15)



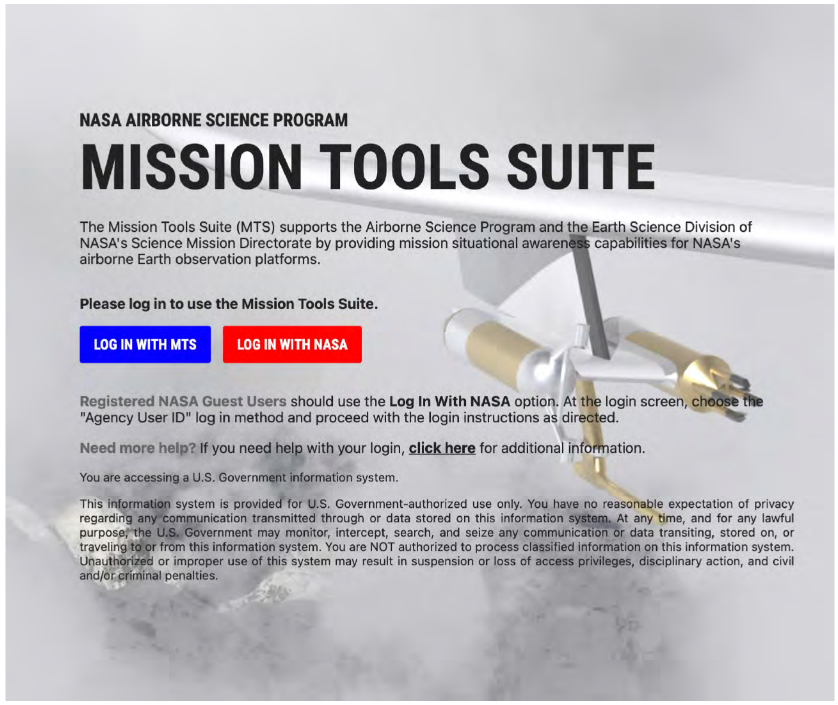
https://airbornescience.nasa.gov/content/3D_Models

The new 3D model Viewer. Image credit: Aaron Duley

(continued from Pg. 14)

Mission Tool Suite – New Features

check out the 3D model viewer and explore our collection of program models and pre-rendered scenes.



The new MTS Login page. Image credit: Aaron Duley

MTS is also pleased to announce the release of single sign-on (SSO) integration using NASA Launchpad. This feature will enable users to seamlessly log in to our platform with existing Launchpad credentials. This new feature will provide several benefits for our users, including enhanced security and convenience. SSO will allow for a more streamlined login experience, reducing the need for multiple usernames and passwords. With the new SSO feature, you will no longer need to remember separate login details for our platform. Simply click on the "Login with NASA" button and follow instructions to access our platform.

We are committed to providing our users with the best possible experience on our platform, and this new feature is just one example of our ongoing efforts to improve and enhance our services. If you have any questions or feedback regarding the new SSO feature, 3D model viewer, or any other capabilities, please don't hesitate to contact our support team.

Thank you for your continued support and interest in the Mission Tools Suite.

SOFRS Corner

Contributed by Vidal Salazar

Science Operations Flight Request System (SOFRS) Corner
SOFRS Website: https://airbornescience.nasa.gov/sofrs

Meet the SOFRS Team

The SOFRS curators are (from left to right): Vidal Salazar, Sommer Nicholas, Stevie Phothisane, and Ayuta Padhi. All four curators are part of the Earth Science Project Office team (ESPO). The SOFRS Project Manager, Vidal, has over 20 years of experience supporting airborne science. Sommer has worked

(continued on Pg. 16)

(continued from Pg. 15)

SOFRS Corner (cont.)

at ESPO for a long time and was recently promoted to a project manager position, AND has become a Civil Servant (Congratulations!!). Stevie, a Deputy Project manager, joined the ESPO team two years ago and became a part of the SOFRS team last year. Ayuta, who has been with ESPO for about two years, is responsible for building and maintaining the IT infrastructure for SOFRS.

If you need flight requests or airborne science support, please don't hesitate to contact the SOFRS curators at **sofrs_curators@airbornescience.nasa.gov**

Calendar of Events

AUVSI XPONENTIAL 2023
May 7-11, 2023
Denver, CO
https://www.auvsi.org/events/xponential/xponential-2023

NASA Carbon Cycle & Ecosystems Joint Science Workshop
May 8-12, 2023
College Park, MD
https://cce.nasa.gov/meeting_2023/index.html

AOS Open Community Meeting
(virtual)
May 17, 2023
Contact Sheri Smith
sheri.l.smith@nasa.gov

AIAA AVIATION Forum
AIAA / IEEE Electric Aircraft Technologies Symposium
June 11-16, 2023
San Diego, CA and On-line
https://www.aiaa.org/aviation/program

2023 ASPRS International Technical Symposium (virtual)
June 12-16, 2023
https://my.asprs.org/2023Symposium/

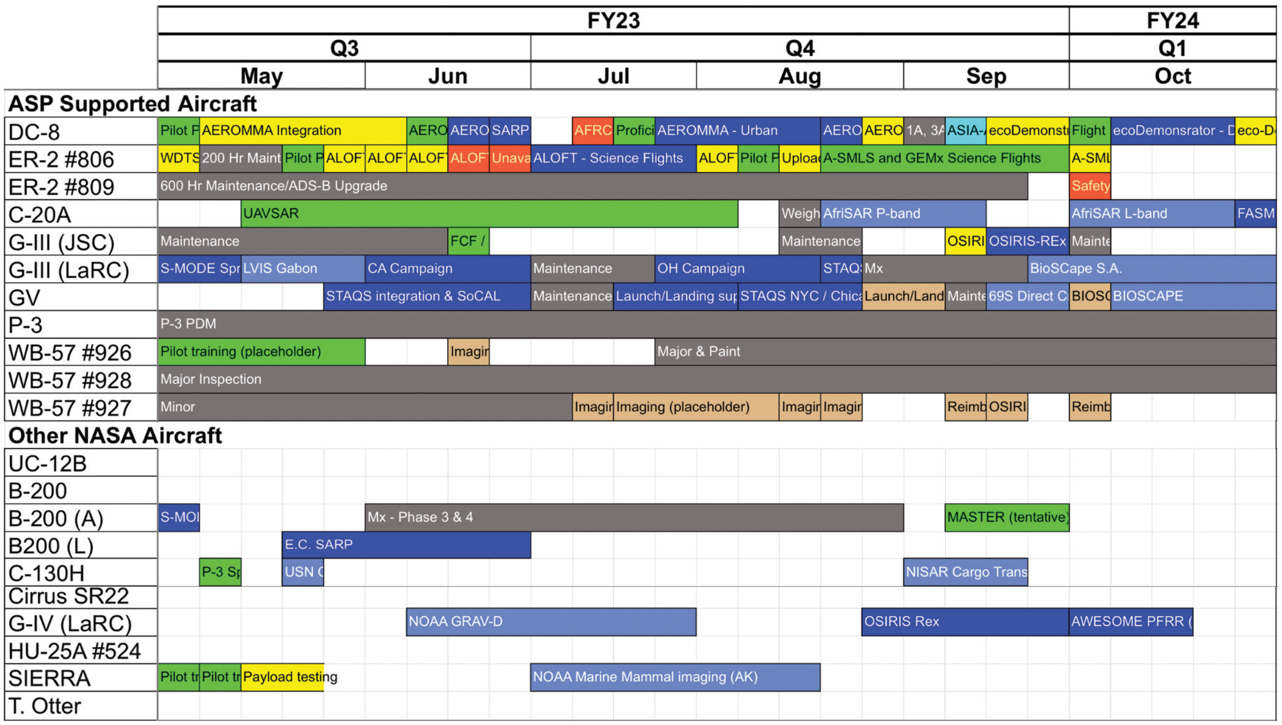
ESTF2023 25th Anniversary ESTO Forum
June 22-24, 2023
Pasadena, CA
https://esto.nasa.gov/forum/estf2023/

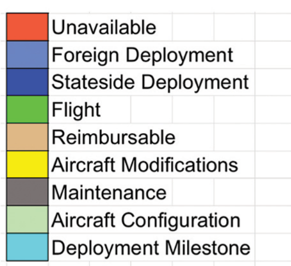
IGARSS 2023
July 16-21, 2023
Pasadena, CA
https://2023.ieeeigarss.org/

2023 SWOT Science Team meeting
September 19-22, 2023
Toulouse, FRANCE
SWOT.jpl.nasa.gov

AGU Fall 2022 Meeting
(In person and online)
December 11-15, 2023
San Francisco, CA
https://www.agu.org/Fall-Meeting

NASA Airborne Science Program 6 Month Schedule Starting May 2023 *(generated 4/27/2023)*





Source: ASP website calendar at https://airbornescience.nasa.gov/aircraft_overview_cal

Airborne Science Program
Platform Capabilities

Available aircraft and specs

Platform Name	Center	Payload Accommodations	Duration (Hours)	Useful Payload (lbs)	Max Altitude (ft)	Airspeed (knots)	Range (Nmi)
ASP Supported Aircraft							
DC-8	NASA-AFRC	4 nadir ports, 1 zenith port, 14 additional view ports	12	50,000	41,000	450	5,400
ER-2 (2)	NASA-AFRC	Q-bay (2 nadir ports), nose (1 nadir port), wing pods (4 nadir, 3 zenith ports), centerline pod (1 nadir port)	12	2,900	>70.000	410	5,000
G-III/C-20A	NASA-AFRC	UAVSAR pod	7	2,610	45,000	460	3,000
G-III	NASA-JSC	UAVSAR pod, sonobuoy launch tube	7	2,610	45,000	460	3,000
G-III	NASA-LaRC	2 nadir ports, dropsonde / sonobuoy	7	2,610	45,000	460	3,000
GV	NASA-JSC	2 nadir ports, dropsonde capability	12	8,000	51,000	500	5,500
P-3	NASA-WFF	1 large and 3 small zenith ports, 3 fuselage nadir ports, 4 P-3 aircraft window ports, 3 DC-8 aircraft window ports, nose radome, aft tailcone, 10 wing mounting points, dropsonde capable	14	14,700	32,000	400	3,800
WB-57	NASA-JSC	Nose cone, 12 ft of pallets for either 3 ft or 6 ft pallets, 2 Spearpods, 2 Superpods, 14 Wing Hatch Panels	6.5	8,800	>60,000	410	2,500
Other NASA Aircraft							
B-200	NASA-AFRC	2 nadir ports	6	1,850	30,000	272	1,490
B-200	NASA-LaRC	2 nadir ports, wing tip pylons, zenith site for aerosol inlet, lateral ports	6.2	4,100	35,000	275	1,250
C-130	NASA-WFF	3 nadir ports, 1 zenith port, 2 rectangular windows, wing mount for instrument canisters, dropsonde capable, cargo carrying capable	10	36,500	33,000	290	3,200
Cirrus SR22	NASA-LaRC	Unpressurized belly pod	6	932	17,500	175	970
Matrice 600 (UAS)	NASA-ARC	Imager gimbal	1	6	8,000	35	3
SIERRA-B (UAS)	NASA-ARC	Interchangeable nose pod for remote sensing and sampling, 1 nadir port	10	100	12,000	60	600

More information available at: https://airbornescience.nasa.gov/aircraft