National Aeronautics and Space Administration

EXPLORE AIRBORNE SCIENCE NEWSLETTER

FALL 2023

Director's Corner

Thanks for your interest in the NASA Airborne Science Program! This latest issue of our newsletter highlights the science and technology development that NASA science aircraft supported over the last 6 months. Our flight teams had an extremely busy summer with nearly every aircraft in the air at some point, studying atmospheric chemistry, arctic ecosystems, and terrestrial structure, much of it in support of Earth Science satellite and ISS missions. We also continued training the next generation of scientists and engineers during SARP. Lots of science was accomplished and all of it done safely! In this latest issue we are also excited to share more information on the new NASA 777, as well as the G-IV for the next generation AirSAR, as both aircraft work through their significant modifications to support earth science. You'll see we also supported other agencies with our unique capabilities including conducting flights for NOAA and USGS. Derek and I are extremely grateful for the flight operations teams at our NASA Flight Operations Centers for all the hard work they've put into the missions that we highlight below.

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What's Inside

S C I E N C E   H I G H L I G H T S

ALOFT Lightning Campaign Flies High on the ER-2

Contributed by Timothy Lang

Members of the ALOFT science team pose in front of the NASA ER-2 during the flight campaign based in Tampa, Florida. Photo credit: NASA

NASA and the University of Bergen in Norway (UIB) teamed up in July 2023 to fly the ER-2 over thunderstorms in search of lightning and gamma-rays. The campaign, called ALOFT (Airborne Lightning Observatory for the Fly's Eye Geostationary Lightning Mapper (GLM) Simulator (FEGS) and Terrestrial Gamma-ray Flashes (TGFs)), was incredibly successful with over 130 TGFs observed across 10 research flights. TGFs are very energetic but short-lived radiation pulses from thunderstorms, and prior to ALOFT they appeared to be up to 10,000 times less frequent

(continued on Pg. 2)

(continued from Pg. 1)

ALOFT Lightning Campaign Flies High on the ER-2

than lightning flashes. However, ALOFT based the ER-2 out of MacDill Air Force Base in Tampa, Florida, providing airborne access to storms over Central America, where TGFs have been more commonly observed. ALOFT used three of its flights to hunt for gamma-rays over Florida as well.

Based on ALOFT observations, TGFs appear to occur while thunderstorms are also producing low-level but longer-lived enhancements in gamma-rays, called glows. ALOFT found that these glows commonly occur during the intensification to mature phases of thunderstorms, suggesting that gamma-ray observations can potentially provide information about thunderstorm evolutionary state. A unique aspect of ALOFT was that these glows could be observed in real time via telemetry from a gamma-ray detector on the ER-2. This enabled ALOFT mission scientists to quickly relay updated instructions to ER-2 pilots Dean Neeley and Kirt Stallings, leading to repeated overflights of glowing thunderstorms and thus maximizing the chances of observing TGFs.

ALOFT also had other goals, including validating lightning measurements by the International Space Station Lightning Imaging Sensor (ISS LIS) and the GLMs. ALOFT made five dedicated underflights of the ISS, and flew entirely within the stereo-viewing region of the GLMs on the West and East Geostationary Operational Environmental Satellites (GOES). In addition, ALOFT sensors tested new concepts for detecting lightning from space, which could be applicable to future NASA lightning-observing missions. Finally, the ER-2 payload included multiple active and passive microwave sensors for characterizing thunderstorm structure and evolution, making ALOFT observations of interest to the future NASA Atmosphere Observing System (AOS) and Investigation of Convective Updrafts (INCUS) missions.

The Principal Investigator of ALOFT is Nikolai Østgaard of UIB, and the Project Scientist is Timothy Lang of NASA Marshall Space Flight Center (MSFC). UIB contributed one gamma-ray instrument, while MSFC provided two lightning instruments and one microwave instrument. NASA Goddard Space Flight Center (GSFC) contributed three other microwave sensors, and the Naval Research Laboratory (NRL) provided a second gamma-ray detector to ALOFT. NASA's participation in ALOFT was supported by the Weather and Atmospheric Dynamics program.

STAQS and AEROMMA Campaigns Complement the Launch of TEMPO

Contributed by Laura Judd, Roy Johnson, and Brenna Biggs

To accelerate NASA's Tropospheric Emissions: Monitoring of POllution (TEMPO) mission science, the Synergistics TEMPO Air Quality Science (STAQS) mission was designed to integrate TEMPO satellite observations with traditional air quality monitoring. Between June 26 and August 26, 2023, the STAQS team successfully completed their airborne air quality campaign. The campaign included 16 science flights in California, 10 science flights in New York City, 10 science flights in Chicago, two science flights in

Group photo of STAQS team with GV at Wright-Patterson AFB. Photo credit: Mónica Vázquez González

Baltimore, and two science flights in Toronto between the LaRC G-III and the JSC GV platforms.

Instrument teams included High Spectral Resolution Lidar (HSRL)-2 and High Altitude Lidar

(continued on Pg. 3)

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STAQS and AEROMMA Campaigns Complement the Launch of TEMPO

Observatory (HALO) from LaRC, and GEO-CAPE (GEOstationary Coastal and Air Pollution Events) Airborne Simulator (GCAS) from GSFC on the G-III, and the Airborne Visible-Infrared Imaging Spectrometer - Next Generation (AVIRIS-NG) from JPL on the GV. The instrument suite mapped out nitrogen dioxide, formaldehyde, aerosols, ozone, and methane multiple times per day within the cities of interest.

Low altitude view from the DC-8 as AEROMMA flies over NYC. Photo credit: Rafael Mendez Pena

A key highlight included coincident measurements collected with TEMPO first light on August 2, 2023 in Chicago and several other days with coincident TEMPO/ airborne measurements. These will be key for assessing TEMPO nitrogen dioxide, formaldehyde, ozone, and aerosol products and using them for science applications. The mission also included partnerships with NOAA, NIST, EPA, and several academic research teams through an effort called AGES+.

In coordination with STAQS, the NASA DC-8 flew the NOAA's Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA) mission, which also completed its flights in August 2023. The NASA DC-8 flew a payload of NOAA and NASA instruments to address emerging research needs in urban air quality, marine emissions, climate feedbacks, and atmospheric interactions at the marine-urban interface and future satellite capabilities of monitoring atmospheric composition over North America.

The DC-8 played the "low-flyer" role in close coordination with the STAQS project's high-flying JSC GV and LaRC G-III platforms.

Group photo of AEROMMA team at WPAFB. Photo credit: Mónica Vázquez González

Over 30 hours were flown from AFRC in June 2023 in conjunction with the Student Airborne Research Program (SARP), collecting data off the Pacific Coast, over the Los Angeles Basin and the Central Valley. In July and August, AEROMMA flew 82 hours out of WPAFB in Ohio over New York, Chicago, and Toronto. Finally, the campaign wrapped up back at AFRC with an additional 26 flight hours in California.

The major objectives for AEROMMA included providing timely information to environmental managers and stakeholder groups about climate and air quality emissions, improving the next generation NOAA weather-chemistry models, reducing global climate model uncertainties, and quantifying emissions, chemistry, and microphysics in urban and marine areas. AEROMMA also aimed to assess value and reduce risks for future satellite missions such as NOAA GeoXO (Geostationary Extended Observations).

The 2023 ABoVE Airborne Campaign Returns to Alaska and Canada

Contributed by Charles Miller and Peter Griffith

NASA's Terrestrial Ecology Arctic Boreal Vulnerability Experiment (ABoVE) team executed its fifth airborne campaign during July-August 2023. The team acquired hyperspectral imagery from the AVIRIS-3 sensor. These acquisitions were guided by the requirements of the ABoVE Phase 3 investigations and requests from ABoVE partners in the U.S. and Canada. The new data complement that collected during the ABoVE airborne campaigns executed in 2017, 2018, 2019, and 2022. The Dynamic Aviation B-200 aircraft (N53W) was based in Fairbank, AK. About 80% of the areas of interest near Fairbanks and north to Deadhorse were collected. The NGEE-Arctic sites on the Seward Peninsula were collected, and sites near Kotzebue, Noatak, and Atqasuk were completed. Good weather forecast for Utqiagvik led the team to try overnighting there but the aircraft developed mechanical problems which led to a week of down time for repairs, after which the weather failed to cooperate. Favorable conditions in southern Yukon allowed science flights to Whitehorse and points south to Skagway, AK. Extraordinary wildfires in Canada prevented planned sorties in northern Yukon and in the Northwest Territories.

ABoVE B-200 aircraft in Fairbanks. Photo credit: Mike Eastwood

ABoVE AVIRIS-ng team. Left to right: Luis Rios (instrument operator), Robin Larsen (pilot), Kait King (pilot), Mike Eastwood (Instrument lead). Photo credit: Peter Griffith

AirSWOT flies Cal/Val Campaign Over the St. Lawrence Estuary

Contributed by Marc Simard, Roger Chao, Alexandra Christensen, and Michael Denbina (JPL) and Pascal Matte (Environment and Climate Change Canada)

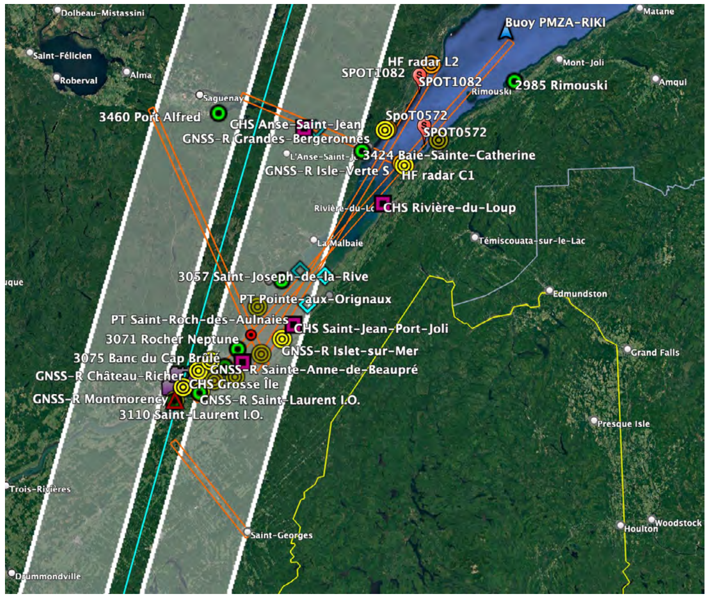
In August 2023, the JPL AirSWOT instrument was flown over the St. Lawrence Estuary and Saguenay Fjord, Québec, to collect water surface elevation measurements coincident with SWOT overpasses and with various in situ measurements. The St. Lawrence Estuary is a highly dynamic system with propagating tides reaching 7m. With its unique geomorphology, characterized by large (>15-km wide) cross-sections and numerous islands, it presents significant spatiotemporal variability in surface conditions at all scales. The adjacent Saguenay Fjord discharges into the St. Lawrence. With high cliffs reaching 350m, the fjord allows scientist and engineers to study layover effects in some areas and for SWOT data validation in a standing tidal wave (low slope) environment. Both waterways encompass a large range of water surface conditions within a finite geographical region and relatively short time scales.

(continued on Pg. 5)

(continued from Pg. 4)

AirSWOT flies Cal/Val Campaign Over the St. Lawrence Estuary

AirSWOT is a Ka-band radar interferometer, typically installed on the fuselage of a King Air aircraft, able to map water surface elevation with a spatial resolution of about 5 meters across a 3 km swath and along flight lines that can be several hundreds of kilometers long. Because it is airborne, it enables on-demand fast repeat measurements that can capture dynamic tidal processes occurring in coastal environments. NASA's Surface Water and Ocean Topography (SWOT) satellite was launched December 16th, 2022 to provide measurements with centimeter-level accuracy of water surface elevations and slopes at an unprecedented high spatial resolution (~50m). However, its 21-day repeat-orbit does not allow consecutive observations during a tidal cycle. AirSWOT is the ideal complementary tool to assess SWOT spatio-temporal capabilities and limitations in these highly dynamic environments by making spatially explicit measurements before, during and after SWOT overpass. In addition to tides, water surface within estuaries is impacted by several other factors such as winds and internal waves, which can be quantitatively characterized and monitored with AirSWOT imagery. An extensive network of water level gauges, HF radars and wave buoys provide water surface's true conditions.



AirSWOT data coverage (orange) on 8/23/23 taken around the early morning SWOT overpass (white shade). Geometric icons indicate the location of continuous in situ measurements. Figure credit: Marc Simard

AirSWOT was stationed in Bangor, Maine and flew the region of interest from midnight to 5:00 am on August 22 and 23, from 9:00 am to 2:00 pm on August 29 and 31. Taking off from Bangor allowed AirSWOT to reach the desired altitude of 28k ft as it neared the region of interest. The first 3 flights coincided with mid-flight SWOT overpasses. The last planned flight was to occur on August 30 but a storm with atmospheric icing forced a delay to August 31. In addition to serving as a cal/val tool for SWOT, AirSWOT data provides both validation of in-situ water level gauges and hydrodynamic model validation. Indeed, our teams use such models to understand and quantify the export of freshwater and carbon into the oceans, and to support navigation, search and rescue, and pollutant recovery efforts.

AirSWOT has previously been deployed extensively to support Earth science missions. This includes several flights supporting NASA's ABoVE campaigns in western Canada and Alaska, and most recently flying a total of 191.8 hours for the Earth Venture Suborbital Delta-X campaign in the Mississippi River Delta in 2021. The AirSWOT instrument was upgraded specifically for the Delta-X mission to improve reliability and processing efficiency.

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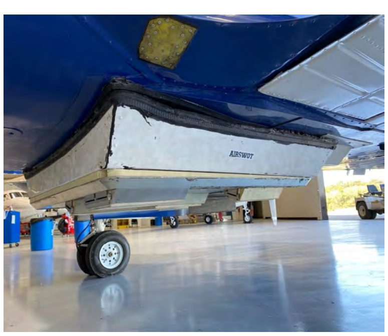
The AirSWOT instrument was flown onboard a Dynamic Aviation King Air aircraft. Photo credit: Roger Chao



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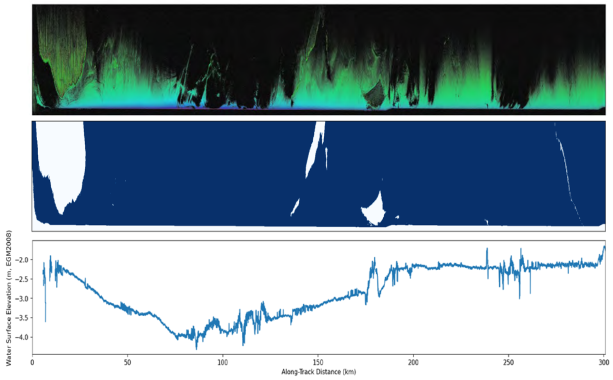
AirSWOT flies Cal/Val Campaign Over the St. Lawrence Estuary



Top: AirSWOT interferogram collected on August 28, 2023 at 13:55 UTC, during a period of falling tide. The flight line begins near Île d'Orléans, Quebec, Canada and extends North-East along the St. Lawrence River. The radar look direction is towards the top of the page. Middle: Mask with water in blue and land in white. Bottom: Corresponding AirSWOT water surface elevation profile showing how the water level varies along-track with respect to the EGM 2008 geoid. While the profile avoids islands, exposed mud flats at low tide may impact elevation measurements around islands. Figure credit: Michael Denbina

In GEMx Mission, NASA Maps Earth Resources in American Southwest

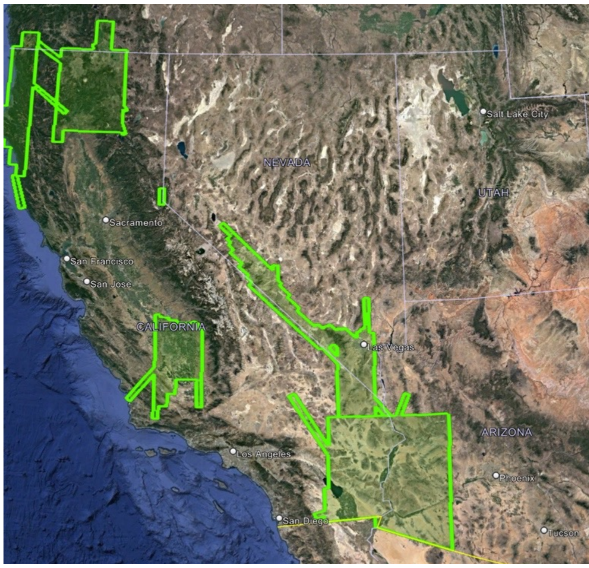
Contributed by Erica Heim

In a collaboration with the United States Geological Survey (USGS), NASA Armstrong Flight Research Center's ER-2 aircraft flew high over the Southwestern regions of the United States, initiating a 5-year project called Geological Earth Mapping Experiment (GEMx). By acquiring hyperspectral data, the GEMx mission seeks to identify and map critical mineral deposits in the western U.S. to determine if there are new or unknown deposits such as lithium and copper.

"Copper has recently been added to the critical mineral list by the Department of Energy," said Dr. Dean Riley, a collaborator on the GEMx project from the University of Arizona, Department of Mining and Geological Engineering. "This mission, data, and its respective data products can help the public along with local, state, and federal agencies make effective decisions regarding management of natural resource deposits including critical mineral resources."

For a project of this scale and detail, the instrumentation must be both precise and sweeping. Using NASA's Airborne Visible/ Infrared Imaging Spectrometer, AVIRIS, Hyperspectral Thermal Emission Spectrometer, HyTes, and MODIS/ASTER Airborne Simulator, MASTER, researchers used NASA's ER-2 to collect the measurements over the country's arid and semi-arid regions.

"For this mission, we are flying the ER-2 at approximately 65,000 feet to acquire wide swaths of data with every overflight. It's thanks to this capability that we can cover such a large area," said Kevin Reath, deputy program. The 2023 campaign included data acquisitions on eight days between September 5th and 26th for a total of nearly 70 flight hours. Data collected covers more than 170,000 square kilometers, including parts of southern Oregon and northwestern California, a southern portion of California Central Valley, southern Nevada/eastern California, and southeastern California to southwestern Arizona, as shown in the figure.



GEMx 2023 campaign areas covered. Figure credit: Raymond Kokaly, USGS

"The U.S. depends on a reliable supply of Earth materials to support its economy and national security," said Raymond Kokaly, research geophysicist with the USGS stationed in Denver, Colorado. "Such materials have been deemed critical minerals because disruption of their supply would have significant negative impacts. Undiscovered deposits of at least some of these critical and strategic minerals almost certainly exist in the United States, but modern geophysical data is needed to increase our knowledge of these

(continued on Pg. 7)

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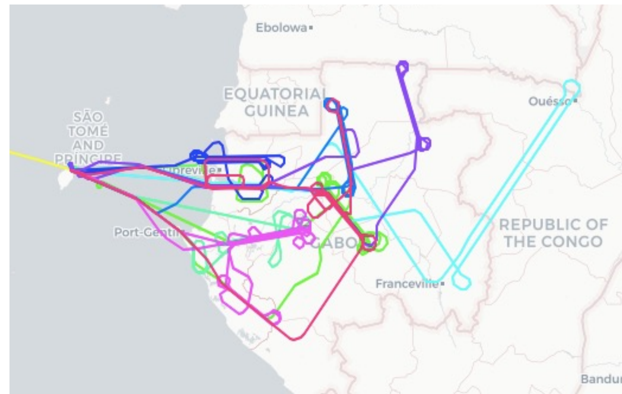
In GEMx Mission, NASA Maps Earth Resources in American Southwest

resources. According to Kokaly, “Analyses of GEMx data will result in actionable information for scoping, prioritizing, and conducting activities under various USGS projects.” The GEMx partnership with NASA is expected to continue for an additional 4 years. As with all NASA projects, the data from this mission will be publicly accessible to the benefit of communities and researchers now and in the future.

NASA Gulfstream-III Aircraft Completes LVIS Overflights of Gabon

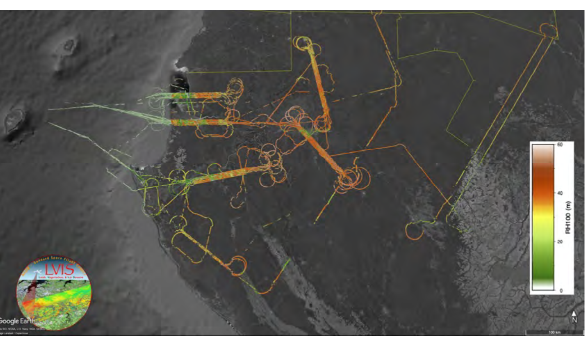
Contributed by Bruce Fisher, Bryan Blair and Michelle Hofton



G-III flight tracks over Gabon

The NASA LaRC G-III aircraft (N520NA), successfully completed multiple overflights of Gabon and adjacent areas in the Republic of Congo. The purpose of this mission, sponsored by the ESD Terrestrial Ecology program, was to measure forest height and structure in Central Africa, and specifically (at the request of the European Space Agency - ESA) to repeat coverage over sites flown as a part of AfriSAR in 2016. The G-III aircraft was deployed to São Tomé, São Tomé and Príncipe,

LVIS topography signals during the mission. The color chart indicates topographical heights.



from May 17 to June 1, 2023. While deployed, the aircraft flew ten science flights (47 research flight hours) with both of GSFC’s Land, Vegetation and Ice Sensor (LVIS) Facility and Classic units as the research payload. LVIS is an airborne, wide-swath imaging laser altimeter system that is flown over target areas to collect data on surface topography and three-dimensional structure of vegetation. The LVIS sensors utilize 1064-nm wavelength lasers and multiple detectors to record the return pulses reflected from the surface, allowing highly-detailed determination of range and return pulse shape. Combined with aircraft position and attitude knowledge, the sensor produces topographic maps with decimeter accuracy and uniquely captures the vegetation height and structure measurements of overflown terrain. One of the instruments was collecting data specifically for GEDI validation, while the other collected data to meet the ESA request. The two LVIS units were installed in the forward and aft nadir portals of the aircraft. A total of 21 flights (81.7 flight hours), including instrument check flights, transit flights and research flights, were flown by the aircraft to accomplish this mission. The aircraft and both sensors performed well throughout the deployment and all major science sites were successfully mapped.

The LVIS team also successfully tested the Starlink high-speed, satellite-based internet at the São Tomé airport. During the deployment, Mr. Tulinabo S. Mushingi, U.S. Ambassador to Angola and São Tomé and Príncipe, visited the NASA G-III aircraft in São Tomé between research flights. The NASA team briefed the ambassador on the science mission, the aircraft’s capabilities and some observations on conducting research flight operations from São Tomé.

Ben Gullett, Foreign Service Officer, U.S. Embassy for Angola and Sau Tome & Principe; Local employee of the U.S. Embassy for Angola and Sau Tome & Principe; Mark T. Sandeen, Research Pilot, NASA Langley Research Center; Tulinabo S. Mushingi, U.S. Ambassador to Angola and Sau Tome & Principe. Photo credit: Michelle Hofton

Student Airborne Research Program (SARP) and SARP East

Contributed by Ryan Bennett, Bruce Fisher, and Brenna Biggs

The Student Airborne Research Program (SARP) is an annual program sponsored by the Science Mission Directorate at NASA Headquarters. SARP provides undergraduate students with hands-on research experience in all aspects of a major scientific campaign. Participants fly onboard NASA research aircraft and assist in the operation of instruments to sample and measure atmospheric gases and aerosols as well as to image land and water surfaces in multiple spectral bands.

NASA SARP-E intern Karla Lemus, on left, assists NASA Scientist Emeritus Anne Thompson as she leads NASA SARP-E interns, to release an ozone sonde from the parking lot of the VCU Rice Rivers Center on June 16, 2023. Photo credit: NASA/ Angelique Herring

	SARP 2023	SARP-E 2023
Location	**NASA AFRC, UC Irvine**	**Virginia, near LaRC**
Timeframe	**June 18 to August 11**	**June 5 to July 28**
Students	**24**	**22**
Mentors	**5**	**5**
Faculty	**4**	**5**
Flight hours	**62**	**16.7**
Number of flights	**13**	**13**
Platforms	**DC-8, LaRC G-III, JSC GV**	**LaRC Cirrus SR22, LaRC B-200**

Each student works on a multidisciplinary team to study surface, atmospheric, and oceanographic processes and develop an individual research project with their mentors. At the end of the program, participants create and give a final presentation to their peers, mentors, and NASA personnel. This year marked the 15th year of the program and – excitingly – the inaugural year of the new SARP East (SARP-E) program on the east coast! For a summary of both programs, please view the table to the right.

The 15th annual SARP completed thirteen total flights using the AFRC DC-8 (5 flights), LaRC G-III (5 flights), and JSC GV (3 flights), representing a total of 65 flight opportunities and the first time that SARP students flew concurrently on three NASA aircraft from three different NASA centers! Students had a unique opportunity to participate in ongoing airborne campaigns as part of the SARP experience – the joint NASA/NOAA Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA) mission on the DC-8, and the NASA Synergistic TEMPO Air Quality Science (STAQS) mission on the G-III and GV. STAQS is described on pages 2 to 3.

Flights were centered around two major regions and themes: the California Central Valley flights focused on dairies, agriculture, and oil field emissions, while the Los Angeles Basin/Southern California flights focused on megacity emissions, diurnal atmospheric composition changes, and Salton Sea emissions. Additional data were collected by the students from ground surveys and whole air sampling at field sites such as the California Central Valley, Salton Sea, Santa Barbara Channel, and Sedgwick Reserve.

The inaugural SARP-E completed thirteen total flights using the LaRC Cirrus SR22 (6 flights) and the LaRC B-200 (7 flights). The aircraft flew over the Chesapeake Bay, beginning from the mouth of the Chesapeake and going north

(continued on Pg. 9)

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Student Airborne Research Program (SARP) and SARP East

in a raster pattern, covering the water ways and tributaries. The payloads on the SR22 and B-200 were the EPA's Transportable Earth Resources Observation Suite (TEROS), and NASA Goddard's Scanning L-band Active Passive (SLAP) instrument, respectively. Additional data were provided to the students for their analysis from a flight of the LaRC G-III aircraft (with no students on-board), equipped with NASA JPL's Airborne Visible/Infrared Imaging Spectrometer - Next Generation (AVIRIS-NG) and NASA Langley's High Altitude Lidar Observatory (HALO).

Group photo of SARP students with the DC-8 at AFRC. Photo credit: Jane Berg

Both the SARP and SARP-E programs were a complete success and will hopefully inspire the next generation of airborne scientists!

Program CAPABILITIES

OPALS Takes to the Skies

Contributed by Gary Ash, Brian Hobbs, Adam Webster, and Brenna Biggs | PI: Mark Zondlo – Princeton University

The OPALS instrument seen from the exterior of the DC-8. Note the metering rods and spherical mirrors seen in the image. Photo credit: Adam Webster

The Open Path Ammonia Laser Spectrometer (OPALS) instrument is a project borne of the minds of principle investigator Dr. Mark Zondlo and his research group in the Civil and Environmental Engineering department at Princeton University. OPALS provides an innovative method to measure in situ ammonia in support of atmospheric chemistry science studies.

Ammonia (NH_3) is a very "sticky" and semi-volatile molecule with a large measurement range (i.e., parts-per-billion near ground sources and parts-per-trillion at higher altitude). Ammonia is challenging to measure using traditional inlet tubes and sample cells: it can aerosolize or vaporize as it enters the warm aircraft cabin, biasing measurements and results. Instead, OPALS is mounted outside the aircraft, eliminating temperature variations and the need for tubing. The instrument uses a Herriott optical cell designed by Princeton University and the National Center for Atmospheric Research (NCAR), which reflects light numerous times between a pair of spherical mirrors separated by Invar metering rods about

(continued on Pg. 10)

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OPALS Takes to the Skies

480 mm apart to minimize thermal expansion and contraction.

Once the cell was built, OPALS had a surprisingly challenging DC-8 integration starting with the 2022 Student Airborne Research Program (SARP), overcome by a multidisciplinary team consisting of personnel from multiple NASA centers, National Suborbital Research Center (NSRC), NCAR, and Princeton University in time for 2023 test flights.

To assist with integration, NSRC designed, fabricated, and assembled a support structure using novel kinematic joints to attach OPALS to the aircraft in an airworthy, safe, and scientifically sound way. The resulting OPALS installation was aerodynamically and structurally complex, requiring detailed analysis of airflow and structure. AFRC and LaRC engineers worked together to define the specific flight conditions to be analyzed. This was no easy task. Given the compressed schedule and almost infinite possible flight conditions, the team developed an analysis matrix that conservatively covered DC-8 operational conditions yet was executable in the time available. Personnel from the aerodynamics branches at LaRC and AFRC worked together to create a full-aircraft Computational Fluid Dynamics (CFD) model for determining aerodynamic loads. They then mapped the results of the CFD analysis to a Finite Element Model of the installation to perform structural analysis, which revealed some areas of the optical cell requiring minor modifications. LaRC manufactured and modified this hardware shortly before the first flight of the instrument, which verified airworthiness on the DC-8.

Ryan Boyd, an alum from the Student Airborne Research Program (SARP) 2022, is now a student in Dr. Zondlo's group. This image shows Boyd working on the OPALS instrument on the DC-8 aircraft. Photo credit: Ryan Bennett

Excitingly, OPALS was finally able to test fly during the NOAA Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA) mission during Summer 2023. OPALS measured ammonia from sources ranging from vehicle combustion downwind of large cities to agricultural air masses.

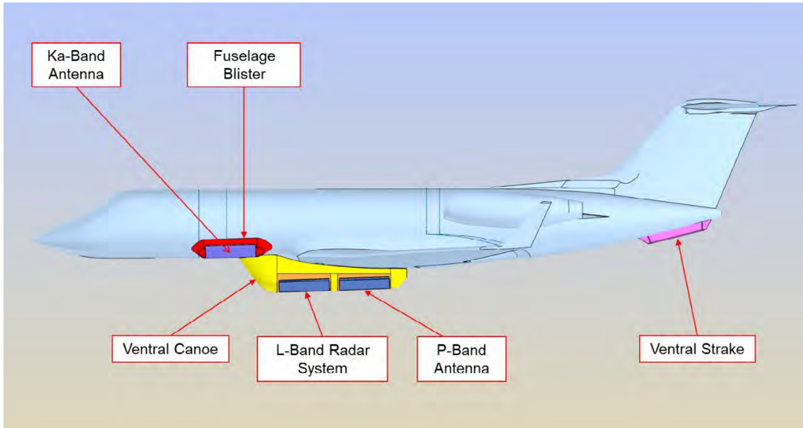
Fortunately, AEROMMA flights confirmed that there were no major optical alignment issues outside the aircraft during flight. However, they also identified potential improvements, something that is nearly impossible to predict based upon laboratory and theoretical studies alone. For example, the team used flight results to improve the output of light into the exterior mirrors as well as laser and fiber optomechanical coupling efficiencies.

Now that the instrument is up and running, the OPALS team has a busy schedule ahead. They will continue to examine in-flight spectral analyses and improve optical signal recoveries and calibrations. OPALS will fly its first designated mission in ASIA-AQ in early 2024. Successful demonstration of the OPALS instrument presents an innovative development in an otherwise difficult-to-measure atmospheric gas.

Next Generation Airborne SAR Capabilities Take Shape

Contributed by Darren Cole

The JPL-developed Next Generation Airborne Synthetic Aperture Radar (AirSAR-NG) instrument will enhance the existing Unmanned Air Vehicle Synthetic Aperture Radar (UAVSAR) instrument and extend the capabilities of NASA's SAR platforms. The Airborne Science Program selected the LaRC Gulfstream-IV aircraft to be modified by AFRC to provide a more capable, versatile, and maintainable AirSAR platform. New features will include:



AirSAR-NG Platform Conceptual Design

- Multiband Radar Mission Capability: Up to three simultaneous frequencies (L-, P-, and Ka-Band) to improve data quality and reduce flights.
- Modular Radar System Design: Radar equipment relocated from external pod to aircraft cabin. Simplifies troubleshooting and maintenance, eliminates need for critical lift procedures.
- Reduced Crew Requirement: Majority of missions will require a single radar operator; cockpit aircrew will replace the dedicated Platform Precision Autopilot (PPA) operator.

The Preliminary Design Review is complete. The team is targeting an initial operating capability in early CY2025. In addition to providing for the AirSAR on the G-IV aircraft, the work the team is completing to implement a new PPA system is being standardized to be interchangeable with other ASP aircraft, such as the JSC G-V and LaRC B777.

UPDATE on the B777 – NASA's New Flying Laboratory

Contributed by Derek Rutovic

Computer rendering of the B777

This past fiscal year has seen a whirlwind of activity surrounding the transformation of the B777 from a passenger aircraft into an airborne research laboratory. It began without a single engineering design requirement committed to paper and has ended with a portion of the detailed design completed, technical drawings released, components purchased, and the start of wire harness fabrication. ASP's cross-cutting engineering team came together

(continued on Pg. 12)

(continued from Pg. 11)

UPDATE on the B777 – NASA's New Flying Laboratory

in October 2022 to begin requirements development and has studiously worked the "in-house" design process completing a Systems Requirements Review in early January, all Preliminary Design Reviews by July, and the first Critical Design Review for the Research Power System in September. To provide context on the extent of this effort, the Research Power System alone comprises a total of 16 electrical drawings over 72 sheets with the critical designs of other complex systems, like the Mission Intercom System, following closely behind. This good work is of no benefit to the science community unless it can be translated into actual aircraft modifications. Selected procurements, especially of long lead items, has been ongoing to ensure that the modification team has the necessary components in hand when engineering designs are complete. In addition, LaRC executed an interagency agreement to access a vendor with an extensive history of modifying Navy aircraft to support the B777. The expanded team is having weekly meetings, working through the completed designs, and implementing plans to modify the B777. The program also completed an exterior scan of the B777, primarily to aid the aerodynamic analysis needed to locate science instruments, probes, and sensors. The following figure shows the computer model stemming from this scan.

The engineering team plans to finish all "in-house" designs by the end of 2023 and have internal modifications completed by the middle of 2024. At that point, the jet will be ready for major maintenance, landing gear overhaul, a new livery, and portal modifications. It should be ready for science in FY25.

PEOPLE of Airborne Science

Erin Justice Retires From ESPO and the SOFRS Team

Contributed by Vidal Salazar

Erin, a dedicated and versatile professional, made significant contributions to NASA's Airborne Science Program (ASP) and NASA's Earth Science Project Office (ESPO) during her tenure over the last 15 years. Erin's technical expertise was instrumental in creating and maintaining critical websites, including the ASP and ESPO sites. However, one of Erin's standout achievements was her pivotal role in the development of the Science Operations Flight Request System (SOFRS). This innovative system has played a vital role in streamlining the request and utilization of NASA research aircraft, helping the airborne science community at large to plan, track, and report on scientific and operational efforts. Erin's knowledge extended beyond web development; she also provided invaluable support for field campaigns, offering technical expertise both remotely from NASA Ames and on-site at locations around the world. Beyond her technical skills, her ability to bridge the gap between technical and non-technical team members was highly valued. Erin's departure from ESPO leaves a void,

Erin Justice

and she will be greatly missed. Her legacy, especially her role in SOFRS's inception and field campaign support, will continue to have a lasting impact on the organization's mission.

In Memoriam – **Brad Lobitz - Pioneer**

Brad Lobitz passed on September 14, 2023. He is survived by his wife Michele and daughter Valeria. Following are sweet memories from several of his NASA colleagues.

Contributed by Lee Johnson

As I recall Brad was raised in Iowa, or one of those other mid-western states that have strong schools, and it showed. He came to us, by way of Louisiana State University, Baton Rouge, where he earned his Masters Degree with a Landscape Architecture thesis entitled, "Correlations of Vegetation with Surface Temperature in Three Louisiana Cities" from the Departments of Physics and Computer Science. He was hired into SGE in 1994, largely to support the remote sensing component in the latter days of the Oregon Transect Project. Somehow his resume had come to the attention of the late Mike Spanner, who was managing the Johnson Services support-services contract at the time. Along with Liane, Cindy, and others, we collaborated with Mondavi and other winegrowers on a series of applied research projects involving vineyards (GRAPES, CRUSH, VINTAGE).

Aero-vironment Pathfinder UAV

Among many other things, Brad was very interested and capable with GPS (which was a lot harder to deal with back then) and had much to do with successfully meshing highly specific ground data with our imagery. A paper we published involving that general topic appeared in Applied Engineering in Agriculture and won honorable mention for best paper of the year by the publisher, American Society of Agricultural Engineers. At that time, Brad was also a key member of the innovative Center for Health Applications of Aerospace-Related Technologies (CHAART) project, which applied remote sensing and GIS technology to public health issues. Among many other things, he led a multi-institutional publication in 2000 that was published in the highly prestigious and selective Proceedings of the National Academy of Sciences. My last project involvement with him was during the UAV Coffee project in the 2000s. This involved a demonstration out of Kauai's Pacific Missile Range Facility of potential commercial applications of high altitude, long endurance UAVs such as Pathfinder. We had many good times hanging out with Vince Ambrosia, Jim Brass and Don Sullivan (with whom we once shared a great rental house right on the beach), Bob Higgens ('Higgie') and many others during down-times in the busy flight/work schedule. Brad went on to collaborate with several Ames investigators, notably including Liane Guild and Matt Fladeland. He eventually departed Ames to take a highly responsible out-of-state tech position with Garmin Navigation.

I greatly enjoyed Brad's company. He had sort of a no-nonsense approach to work, and seemingly life in general, but combined with a wry sense-of-humor and a quick chuckle. He had a wealth of knowledge with all things computer. Whenever I was stumped by an image processing question or data analysis problem, I could spend a bunch of time trying to figure it out, or just saunter down to Brad's office and he'd get me going. It might have gotten to the point that he'd partially close his door when he saw me approaching. Probably fair to say I was not the only one in the organization who relied on him in this way. Always generous with his time. A valued contributor to any project he was involved with, and terrific asset to the entire organization.

Contributed by Ric Kolyer

Brad was the original remote drone pilot for the SIERRA-A UAS at NASA Ames. And, I believe, the first remote pilot at NASA-ARC for any Category III UAS. He was the chief remote pilot for the NASA CASIE mission in 2009 to map Arctic Sea ice using a one-of-a-kind remotely piloted aircraft (SIERRA). The aircraft was based at Ny-Alesund, a remote Arctic research station on the Norwegian island of Svalbard. Science flights were long; that didn't allow the crew to go back to the chow hall for lunch. So, the crew packed lunches instead. No refrigerators at the work site, a missile launch bunker, so the lunches were left outside where it was cold. The food kept disappearing. Brad bent his mind to the puzzle, as he always did, and figured out the timing of the thefts. Sure enough,

(continued on Pg. 14)

(continued from Pg. 13)

In Memoriam – **Brad Lobitz - Pioneer**

at the right time we all looked out the blast window to see a gorgeous arctic fox jumping up on top of the equipment pallets, where the sandwiches were, and watched it eat the lunches. The time window was 10:15 – 10:30; apparently, the fox had a route, and we were at the midmorning stop. My favorite memory is shown in the photo: Brad sitting in an open cargo trailer manning the SIERRA-A UAS ground station in Ny-Alesund. Mountains and glaciers in the background. Completely bundled up against the arctic air. Grinning like a maniac.

Ny-Alesund deployment in 2009. Brad Lobitz (left) and Ric Kolyer (right). Photo credit: Mark Sumich

Brad was also the chief operator of a NASA greenhouse gas sensing payload that had been installed aboard a commercial lighter-than-air ship. Mapping greenhouse gases was a collaborative project between the airship operator and NASA. The airship was based at Moffett Field. When the airship needed to fly to a destination in southern California, he was on board operating the payload. The transit flight route, which took them south along the coast, was just a couple of miles offshore. The flight was at an average altitude of five thousand feet. The airship's low flight speed ensured the flight duration was several hours. When asked about the flight, with unmatched views of the gorgeous California coast from Monterey, past Big Sur, the Channel Islands and points southward, he responded in his usual low-key way, "the view was very nice."

Contributed by Liane Guild

Brad also spent time working on coral reef remote sensing projects in Puerto Rico and the U.S. Virgin Islands beginning in 2005 to optimize measurements of the spectral properties of coral reef ecosystem components. Brad spent much time underwater, free diving with the team and getting a personal understanding of the challenges of remote sensing through the sea surface with light scattering through the water column and from the shallow benthic ecosystem. Brad's expertise in optics provided an insight into optimal instrumentation and discovered stray light artifacts from a NASA airborne imaging spectrometer. This identified challenges that further supported the need for tuning imaging spectrometers for aquatics darker targets.

The coastal aquatics team at NASA ARC also sought Brad's expertise to optimize flight planning for the field vicarious calibration of the airborne imaging spectrometer along coastal Monterey Bay, California and nearby inland waters beginning in 2011. His early work has contributed to these protocols still used in the field and for coastal airborne campaigns. We could not have gotten off the ground without Brad.

Contributed by Cindy Schmidt:
In the late 1990s/early 2000s I was working with Brad on the CHAART project. In addition to writing his outstanding cholera paper (mentioned above), Brad also helped develop training materials to train health professionals from a variety of countries including Mali, Japan, Kenya, the UK, India

(continued on Pg. 15)

La Parguera, Puerto Rico field team 2006: Phil Sollins, Roy Armstrong, Liane Guild, Randy Berthold, and Brad Lobitz following a day in the field. Photo credit: University of Puerto Rico

(continued from Pg. 14)

In Memoriam – Brad Lobitz - Pioneer

and several other countries. This picture was taken during an outing with one of our trainees from Brazil, Marcia Castro. Also in the picture is Jane Zhang, Louisa Beck, Marcia, Cindy and Brad circa 2003.

CHAART team members with trainee, Marcia Castro from Brazil. Photo credit: NASA

Calendar of Events

AGU Fall 2023 Meeting (In person and online)
REGISTRATION IS OPEN
December 11-15, 2023
San Francisco, CA

IMPACTS 2023 Science Team Meeting
October 24-26, 2023
Westin Annapolis, Annapolis, MD

S-MODE Science Team Meeting
November 7 - November 9, 2023
NASA ARC, CA

NASA Surface Topography and Vegetation (STV) Meeting
November 14-15, 2023
Pasadena, California

American Meteorological Society (AMS) 104rd Meeting
January 28 - February 1, 2024
Baltimore, MD

AGU Ocean Science Meeting 2024
February 18-23, 2024
New Orleans, Louisiana

IEEE Aerospace
March 2-9, 2023
Big Sky, MT

Future of Greenland Ice Sheet Science (FOGGS) Workshop
April 3-5, 2024
Moscow, Idaho

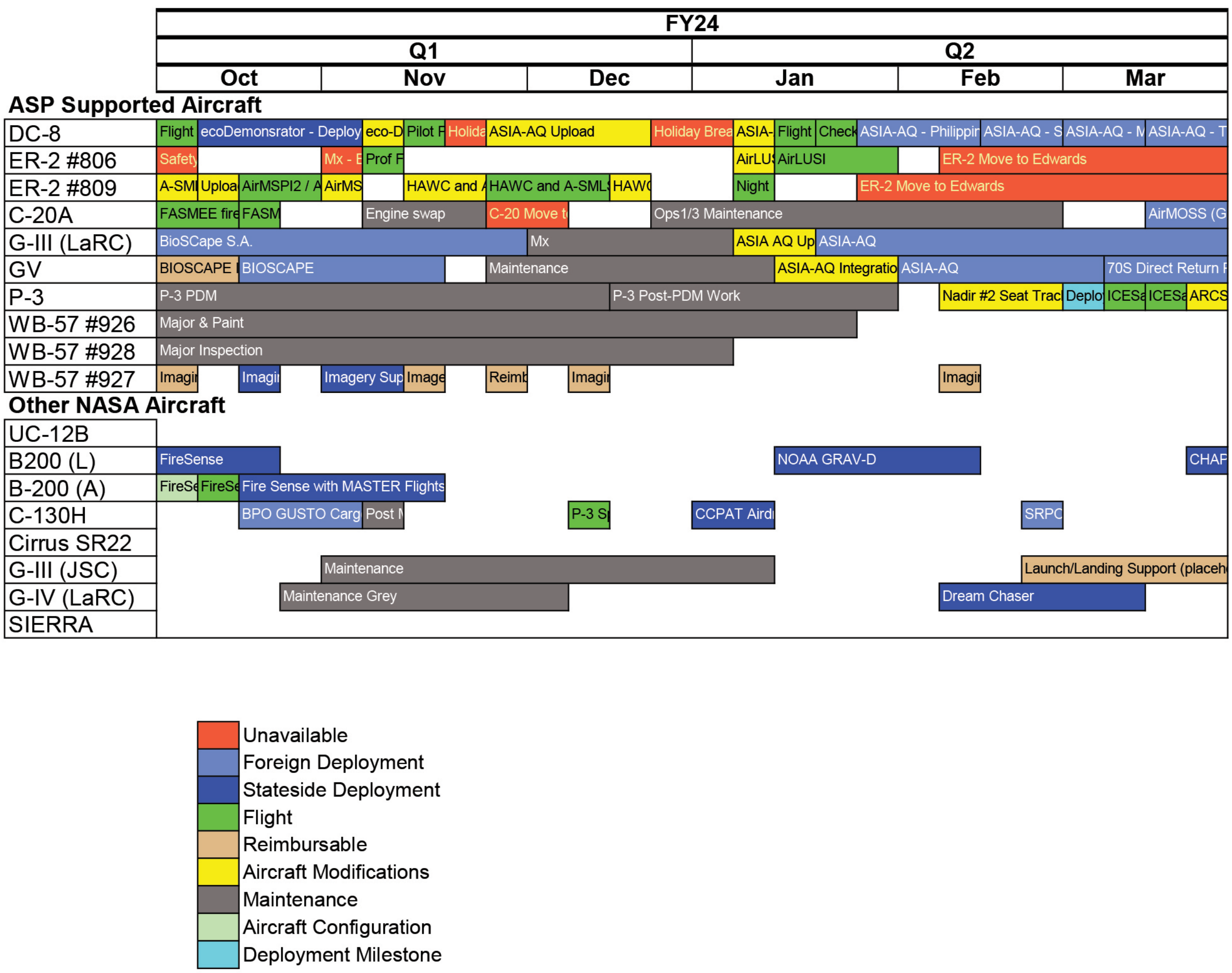
Spring Planetary Boundary Layer (PBL) Workshop
For details visit:
https://science.larc.nasa.gov/pbl/

AUVSI XPONENTIAL 2024
April 22-25, 2024
San Diego, CA

ABoVE 10th Science Team Meeting
May 21-24, 2024
Boulder, CO

IGARSS 2024
July 7-12, 2024
Athens, Greece
Abstract Submissions Open Nov. 1, 2023

NASA Airborne Science Program 6 Month Schedule Starting October 2023 *(generated 10/11/2023)*



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-LaRC	2 nadir ports, dropsonde / sonobuoy	7	2,610	45,000	460	3,000
G-IV	NASA-LaRC	AirSAR next gen (future)	7.5	5,610	45,000	459	5,130
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**