National Aeronautics and Space Administration

EXPLORE AIRBORNE SCIENCE NEWSLETTER

Fall 2022

Leadership Corner

Welcome to the Fall 2022 edition of the Airborne Science Program newsletter! The Program had a strong summer, finishing the Dynamics and Chemistry of the Summer Stratosphere (DCOTSS) mission studying thunderstorm convection over the Midwest (ER-2), as well as supporting the completion of the Cloud Processes Experiment (CPEX) on the DC-8 out of Cape Verde. The WB-57 deployed to South Korea loaded with science instruments for Asian Summer Monsoon Chemical & Climate Impact Project (ACCLIP) to study how Western Pacific cyclones aid in the transport of pollution into the Stratosphere. And even though Operation Ice Bridge is over, we continue to support ICESat-2 cal/val efforts on the GV. We also supported the Surface Biology and Geology High-Frequency Time Series (SHIFT) campaign, which looked at high temporal resolution spectroscopy data over the California coastline. The Student Airborne Research Program (SARP) had its 14th successful year with students back on the DC-8.

In addition to all the great science and technology flown this year, NASA also made a significant decision in response to recommendations by Congress and the National Academies of Science, to replace the NASA DC-8 with a Boeing 777. This new flying laboratory will serve generations of scientists with much longer range and endurance, supporting global measurements in support of NASA satellites and models. We also made the G-III at LaRC

(continued on Pg. 2)

What's Inside

SCIENCE HIGHLIGHTS

ER-2 aircraft and NASA AFRC on the last flight of the project.

DCOTSS Completes Airborne Data Collection

Submitted by Dan Chirica

The main goal of the Dynamics and Chemistry of the Summer Stratosphere (DCOTSS) project is to study the lower stratosphere. During the summer, strong convective storms over North America overshoot the tropopause into the lower stratosphere. These storms carry water and pollutants from the troposphere into the normally very dry stratosphere, where they can have a significant impact on radiative and chemical processes, potentially including stratospheric ozone. Material transported from the troposphere to the stratosphere by these

(continued on Pg. 2)

(continued from Pg. 1)

DTOSS Completes Airborne Data Collection

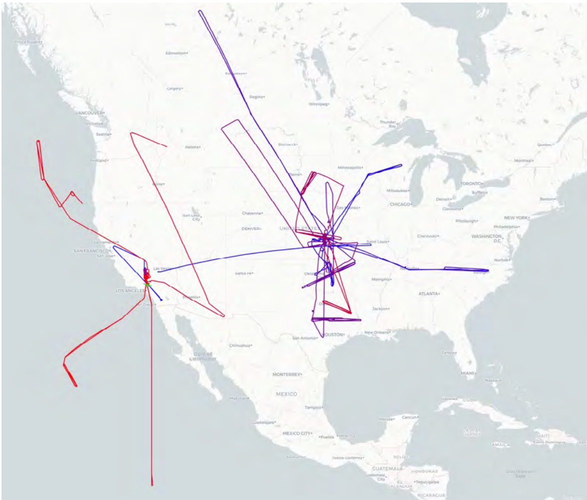
storms may be trapped by the atmospheric circulation in the lower stratosphere. During the summer, the atmospheric circulation over North America is dominated by a large high-pressure system known as the North American Monsoon Anticyclone (NAMA).

DCOTSS, an EVS-3 project, uses the NASA ER-2 high-altitude research aircraft to measure the composition of these convective plumes and determine their effects on the chemistry and composition of the stratosphere. ER-2 flights for DCOTSS were based in Salina, KS, which offers an ideal location for sampling convective plumes in the stratosphere. The ER-2 carried an extensive suite of instruments to measure trace gases and aerosol properties and can operate at altitudes as high as 70,000 feet. Commercial airliners, by comparison, typically fly at around 35,000 feet.

In summer 2022, the DCOTSS team successfully concluded all the intensive field observations planned for this project. DCOTSS now moves to the data analysis and publication phase of the project. Despite continuing challenges and delays related to the COVID-19 pandemic the project succeeded in meeting all proposed observational thresholds. For the 2022 deployment, two other organizations (NASA LaRC and Lawrence Livermore National Laboratory), independently launched radiosondes in coordination with the ER-2 flights.

During the 2022 summer DCOTSS deployment, the ER-2 flew 15 flights for a total of 102.5 hr, of which 85.5 hr (12 flights) were science flights. Including the 2021campaign, DCOTSS flew 31 flights for a total of 200 flight hours, of which 24 were science flights totaling 168.5 flight hours. Principle investigators for the DCOTSS mission are Kenneth Bowman (TAMU) and Frank Keutsch (Harvard). Project management has been provided by Dan Chirica (ESPO).

DCOTSS 2022 Flight tracks. Flights into Canada and the Pacific are survey flights for comparison data.



(continued from Pg. 1)

Leadership Corner (cont.)

dropsonde-capable, increasing its multidisciplinary capability. Lastly, I also want to highlight our incredible logistics support staff, including Loui Staines at Johnson Space Center, whose dedication and hard work makes these missions go! Thanks to them and thanks to you for taking the time to catch up on Airborne Science at NASA.

Bruce Tagg
Director,
Airborne Science Program

Derek Rutovic
Deputy Airborne Science
Program Director - Operations

Successful ACCLIP Mission returns from Korea

Contributed by Jhony Zavaleta

NASA and the National Science Foundation's National Center for Atmospheric Research (NCAR) conducted a jointly funded two-month campaign this during summer 2022 in the Republic of Korea: the Asian Summer Monsoon Chemical & CLimate Impact Project (ACCLIP). Two

(continued on Pg. 3)

ACCLIP Aircraft at Osan Air Base (NASA WB-57 and NCAR GV)

(continued from Pg. 2)

Successful ACCLIP Mission returns from Korea

aircraft, the NASA WB-57F and the NCAR G-V, were outfitted with state-of-the-art sensors. Approximately 100 scientists from the U.S. and other international research organizations participated in ACCLIP.

ACCLIP Team at OSAN AB

The Asian Summer Monsoon (ASM) is the largest meteorological pattern during the Northern Hemisphere (NH) summer season. Persistent convection and the large anticyclonic flow patterns in the upper troposphere and lower stratosphere (UTLS) associated with ASM lead to a significant enhancement in the UTLS of trace species from pollution and biomass burning origins. The monsoon convection occurs over South, Southeast, and East Asia, a region of uniquely complex and rapidly changing emissions tied to both its high population density and significant economic growth. The coupling of the most polluted boundary layer on Earth to the largest dynamical system in the summer season through the deep monsoon convection has the potential to create significant chemical and climate impacts. An accurate representation of the ASM transport, chemical and microphysical processes in chemistry-climate models is much needed for characterizing ASM chemistry-climate interactions and for predicting its future impact in a changing climate. Therefore, the ASM plays a key role in ACCLIP, since it fundamentally sets up the anti-cyclone and leads to the uplift of various gases from the surface of Asia into the UTLS. The tall thunderstorms of the monsoon in Southern Asia can pump air and pollution from the surface to altitudes greater than 50,000 feet. Eventually, this air from the surface gets streamed to higher latitudes and mixed across the Northern hemisphere.

ACCLIP's main goal was to observe the various gases and particles that are being shed from the anti-cyclone into the rest of the Northern hemisphere, and then determine how they might be impacting the Earth's ozone layer and climate. A total of 31 research flights were conducted by ACCLIP aircraft: 14 by the NSF/NCAR G-V, and 17 flights by the NASA WB-57F. On Sept. 1st, the WB-57F had the unique opportunity to conduct measurements over portions of super typhoon Hinnamnor.

With the field portion of ACCLIP having just concluded, the team is currently working on merging data files from both aircraft and planning on a post-field Science Team Meeting in the month of November. While it is too early to determine or announce any scientific results, an important observation made has to do with the geographical extent of the monsoon, as we observed a larger eastward extension, compared to what the models had predicted.

NASA GV returns to Greenland for ICESat-2 Summer Sea Ice Cal/Val

Contributed by Nathan Kurtz

NASA's Ice, Cloud, and land Elevation Satellite 2 (ICESat-2) has been taking global measurements of surface height since October 2018. A key part of ICESat-2's science objectives is the measurement of the Earth's polar sea ice cover, specifically the retrieval of sea ice freeboard (the portion of sea ice and snow floating above the water surface), which is then used to determine the total thickness of the sea ice. In the Arctic, the time series of measurements from ICESat (launched in 2003) to ICESat-2 has shown a loss of nearly 6,000 cubic kilometers, or one-third of the total volume of Arctic sea ice in the last two decades, driven largely by declines in the multi-year ice coverage and the transition to a dominantly seasonal ice cover. This earlier measurement time series used data from the fall

(continued on Pg. 4)

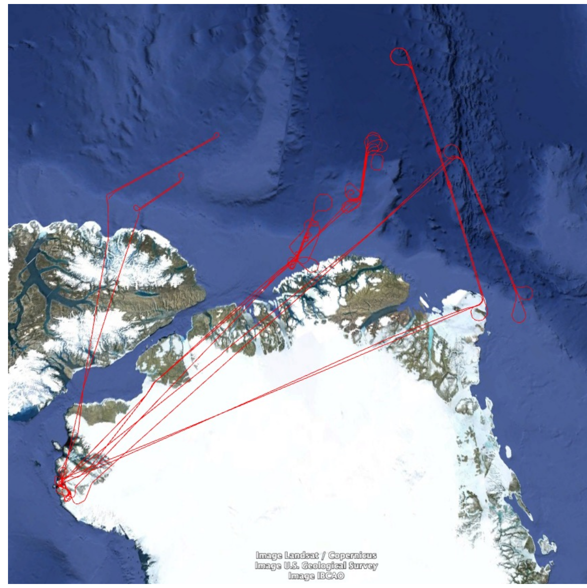
(continued from Pg. 3)

NASA GV returns to Greenland for ICESat-2 Summer Sea Ice Cal/Val

and spring months when good data were available from each satellite. However, developing a year-round sea ice thickness time series would be extremely beneficial for better understanding Arctic sea ice thickness change and improving seasonal sea ice predictions and forecasts. Recent measurements from ICESat-2 have shown great promise towards the potential retrieval of sea ice freeboard and thickness during the summer melt season, due to the strong capability of ICESat-2 to measure through clouds that are prevalent in the summer time as well as the small footprint size of the laser, which is suitable for the heterogeneous surface of summer sea ice. But the summer melting of snow on sea ice causes the formation of melt ponds on the surface which can contaminate the measurements of sea ice freeboard and thickness from the green (532 nm) laser used by ICESat-2.

To help better understand the measurements of Arctic summer sea ice freeboard from ICESat-2, the mission launched an airborne calibration and validation campaign using the NASA GV based out of Thule, Greenland. The GV was equipped with NASA's Land, Vegetation, and Ice Sensor (LVIS) laser altimeter and camera system as well as the Chiroptera-4X commercial lidar and imaging system operated by the Bureau of Economic Geology at the University of Texas at Austin. A total of six science flights were conducted between July 11-26, 2022. The flights targeted ICESat-2 orbits in regions with different sea ice conditions, including young ice, older consolidated ice, melt ponds at different stages of draining, ridged and smooth ice. The first two flights used LVIS to map long lines along the ICESat-2 orbit track. The remaining four flights were "race-track" patterns which flew short repeat lines along two of the three ICESat-2 strong beams at high altitude (~33,000 feet) to obtain broad coverage with LVIS, and multiple passes at low altitude (~1,600 feet) to obtain coverage with the bathymetric and topographic dual lidar system from Chiroptera, which accounted for sea ice

Arctic summer sea ice showing melt ponds, ridges, and exposed open ocean. Photo credit: Marco Bagnardi



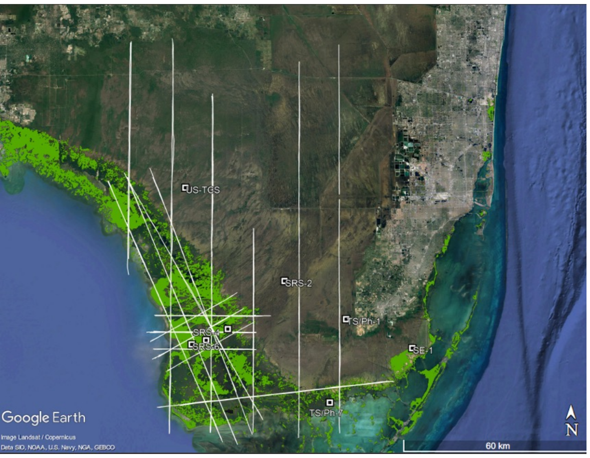
Map of GV flight lines. Note the spirals to lower altitude over the sea ice.

drift during the time between the airborne measurements and satellite overpass. The final flight took advantage of the Cryo2Ice campaign conducted by the European Space Agency to create an orbital resonance between ICESat-2 and their CryoSat-2 radar altimeter and obtained coincident data along the two satellite tracks.

The three primary goals of the campaign were to: 1) Assess the ICESat-2 sea ice height (ATL07) and freeboard (ATL10) standard data products during the Arctic summer melt season. 2) Improve ICESat-2 ATL07 and ATL10 accuracy and precision during the Arctic summer melt season. 3) Assess the feasibility for a melt pond depth recovery algorithm that could become part of the ICESat-2 set of standard data products. The campaign hosted media personnel from NASA, Spotify, and CNN with further coverage during the campaign in USA Today. Final processing of data products from the campaign is ongoing with a public release of all data expected in l ate 2022.

NASA's Carbon Monitoring System supports multi-year **BlueFlux Campaign**

Contributed by Ben Poulter and Glenn Wolfe



CARAFE flightlines from April 2022 (white) showing location of mangroves in Southern Florida.

Mangrove ecosystems are among the most productive ecosystems in the world, storing massive amounts of carbon in their stems, soils and complex root systems that buffer shorelines from erosion and provide habitat for fisheries. Over the past several decades, coastal development, rising sea-level, and increasing hurricane severity have led to the loss of mangroves. Recently, organizations proposing nature-based solutions to climate mitigation have renewed their interest in conservation and restoration of these regions. NASA GSFC's BlueFlux field campaign, supported by NASA's Carbon Monitoring System (CMS), kicked off in 2022 to quantify the carbon cycle of mangroves using field and aircraft measurements, combined with space-based instruments on the International Space Station (ISS), as well as polar orbiting missions. The carbon products developed from BlueFlux will enable conservation and restoration stakeholders to better understand how mangroves can contribute to 'blue carbon' initiatives that intend to mitigate climate change through nature-based climate solutions.

A key science measurement being made for BlueFlux is the exchange of carbon dioxide and methane between mangroves and other wetland surfaces and the atmosphere. The NASA Carbon Airborne Flux Experiment (CARAFE) payload, previously flown in an EVS mission, is being used to measure these fluxes using a combination of gas analyzers and a wind sonde flown on a Dynamic Aviation Beechcraft King Air. The approach derives fluxes using the eddy covariance method, integrating the covariance of high frequency changes in wind direction and trace gas concentration. Six deployments are planned, with the first test flights carried out in April 2022 and the first science flights taking place in October 2022. Flights at altitudes of 100-meters are being made over Southern Florida over the Everglades and Big Cypress National Parks (Figure below) with roughly 25 flight hours per deployment covering large areas not represented by stationary flux towers.

The CARAFE measurements will be combined with field measurements, where field ecologist teams from Yale University and East Carolina University and collecting information that will be used to partition the fluxes to individual ecosystem components. For example, chambers are measuring the gaseous fluxes of methane and carbon dioxide from stems, soil, roots (pneumatophores) and water, and terrestrial laser scanners are collecting structural information on the volume of emitting surfaces to enable scaling of individual components back to the ecosystem (Figure below). The NASA Global Ecosystem Dynamics Investigation, GEDI, waveform lidar instrument aboard the ISS, along with surface reflectance measurements from NASA's MODIS instrument aboard Terra and Aqua will use the CARAFE data to train machine learning models that will develop a twenty-year daily time series of gridded carbon flux products for Southern Florida and potentially the Caribbean region.

Photo of vegetation taken from the April 2022 mission and showing how the fluxes measured by the aircraft come from a mix of vegetation types and surface features that the ground campaign will separate.

The 2022 ABoVE Airborne Campaign
returns to Alaska and Canada

Contributed by by Charles Miller

After a two-year hiatus due to the global pandemic, NASA's Terrestrial Ecology Arctic Boreal Vulnerability Experiment (ABoV) E team executed its fourth airborne campaign during July-August 2022. The team acquired hyperspectral imagery from the AVIRIS-NG sensor as well as L-band polarized, interferometric synthetic aperture radar (PolIn-SAR), provided by JPL under the instrument name UAVSAR. These acquisitions were guided by new ABoVE Phase 3 investigations and new 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, and 2019. Coordination of the AVIRIS-NG flights with German Space Agency's CoMET 2.0 Arctic payload enabled exploration of Arctic methane emissions using multiple complementary remote sensing instruments including airborne precursors for the MERLIN and CO2-M satellites.

Total flight hours for the AVIRISNG on a Dynamic Aviation B-200 were 116.3. Total flight hours for the JPL UAVSAR on the Armstrong C-20A aircraft were 55.4. Both aircraft were based in Fairbank, AK. In addition, Goddard's Lidar, Hyper-spectral and Thermal (G-LiHT) payload, flying on a commercial A-100 aircraft out of Kodiak and Aniak, flew 117.2 hours, primarily in support of Forest Inventory and Analysis (FIA) data collection, but also contributing carbon monitoring data to ABoVE.

Public events in Yellowknife, NT and Fairbanks, AK allowed local residents to tour the C-20A aircraft and learn more about how NASA is helping them understand and protect their lands, waters, and the critical services these resources provide.

The Government of the Northwest Territories sponsored interns Ryan Walsh (2nd from right) and Jacki Tsetta (far right) to join the ABoVE L-band SAR team on science flights. They are pictured here with instrument operator David Austerberry and ABoVE Project Manager Peter Griffith in Yellowknife NT after the 16 August, 2022 sortie.

The L-band SAR team were joined by DLR's CoMET 2.0 Arctic team and the HALO aircraft (right) in Yellowknife, NT for a public event on 16 August 2022. 50 Yellowknifers toured the aircraft and learned about the measurements that each team are making. The CBC, Cabin Radio and other Canadian press conducted interviews and reported on the event.

14th Annual SARP

Contributed by Brenna Biggs

The 14th annual NASA Student Airborne Research Program (SARP) occurred June 12, 2022 through August 5, 2022. SARP is an eight-week internship for 28 senior undergraduate students. This hands-on research experience gave the interns the unique opportunity to fly aboard the NASA DC-8 aircraft based at AFRC in Palmdale, CA. They then spent the remainder of the summer conducting a focused project in Earth system science using NASA airborne and remote sensing data in one of four topical areas – land, air, oceans, or aerosols. Students were mentored by graduate students and faculty from UC Irvine, UC Santa Cruz, UC Santa Barbara, San Diego State University, UC Riverside, Arizona State University, and CSU San Bernardino.

SARP continues to promote diversity, equity, and inclusion in STEM disciplines. The 2022 interns were selected from 28 institutions in 17 states and Puerto Rico, with nearly one third of the students

(continued on Pg. 7)

(continued from Pg. 6)

14th Annual SARP

Students and flight crew pose next to the NASA DC-8 aircraft at AFRC B703 after the first science flight of the program.

from a minority-serving institution. Twelve of the students attended an institution that was not represented in SARP in previous years, and well over half of the interns came from institutions that offer limited research opportunities.

During their time at AFRC, students networked with NASA personnel and distinguished professors, toured various platforms, attended several lectures from prominent scientists, and – perhaps most excitingly – participated in three science flights on the NASA DC-8 aircraft. Students also collected additional scientific data through sonde launches, mobile lab trips, and local ground truthing. Students launched ten sondes near Palmdale to collect vertical profiles of meteorological data

After two weeks of rigorous letures and sampling opportunities at AFRC, the program moved to the UC Irvine campus. For the remaining six weeks of the program, students learned how to code using various programming languages, analyzed samples collected during the DC-8 flights in the Rowland-Blake laboratory, arranged weekly group dinners, and hosted special guests such as Karen St. Germain and Kate Backer from NASA Earth Science Division. At the end of the summer, students presented their results to their peers, NASA guests, and friends and family. Four exceptional students were fully funded to present their research at the American Geophysical Union (AGU) 2022 Fall Meeting this December.

A SARP student demonstrates how to use gas chromatography to determine the methane concentration in samples collected during flights on the NASA DC-8 to special guests Karen St. Germain and Kate Becker during a tour of the Rowland-Blake laboratory at UC Irvine.

Aircraft NEWS

LaRC G-III dropsonde capability and maintenance completed in Collaboration with JSC

Contributed by Frank Jones

Dropsonde port on the LaRC G-III aircraft

Through a collaboration/partnership with JSC, the LaRC G-III (N520) just completed its 72-month scheduled maintenance at the JSC facility, utilizing resource from both Centers. Furthermore, the aircraft, which already sports two nadir ports for science instruments, was modified with dropsonde/sonobouy launch capability and is ready for science.

The photo below shows the dropsonde modification to the G-III. We collaborated with JSC and used their engineering design for dropsonde modification. The engineering was reviewed and approved at LaRC and then we modified the G-III to enable dropsondes to be launched from the aircraft. Dropsondes are loaded int the launch tube and then released out the bottom of tube

(continued on Pg. 8)

(continued from Pg. 7)

LaRC G-III dropsonde capability and maintenance completed in Collaboration with JSC

into the atmosphere. (The second photo is the launch tube, and it bolts to the cabin tube), This is the same dropsonde system used in the JSC G-III (N992), making it transparent to the researchers and providing a cross-cutting capability. This system allows for a wider range of dropsondes that can be used for profiling in situ atmospheric data and can be launched from 45,000 ft. This system was installed to support Aerosol Wind Profiler (AWP) flight campaign in the first quarter of FY2023. This G-III is the first Gulfstream aircraft in the Agency to have both 2 nadir portals and a dropsonde capability.

Launch tube installation on the LaRC G-III aircraft

PEOPLE of Airborne Science

Meet ASP Logistics Rock Star – Loui Staines

Contributed by by Derek Rutovic

The most visible portions of the Airborne Science Program (ASP) will always be the deployments that we execute around the world with "NASA" emblazoned on the aircraft, and as a result, the public and community are familiar with our aircrew, maintenance, and engineers who work tirelessly to ensure mission success. However, like the majority of icebergs lying beneath the surface, there exists an army of people dedicated to their work that few may know who toil equally and have the same impact to the Program. Loui Staines is one of those people. Loui is the senior procurement buyer for the Yulista support contract that provides services to our aircraft at JSC, LaRC, and the WFF. Logistics is the key to everything we do. We cannot fly if we do not have an adequate logistics posture to sustain our aircraft. As many in the Program know, we usually only have one aircraft for a mission. When a part fails with no spares on hand, the mission only goes forward when somebody takes a procurement action to find a solution. Loui has been and continues to be that "go-to" person for the ASP. When a mission is stuck, he has worked the days and hours necessary to get the job done seeing it through until the part is delivered to the aircraft. Given that the prime Yulista contract is at JSC, this has

normally meant working on the remote sensing GV and UAVSAR G-III, but Loui was tasked this year with procuring the new ASP large aircraft, to replace the DC-8 when the time comes. He has excelled in this role, working with vendors, and searching for every last aircraft that might be available for purchase. The procurement is coming to an end, and the ASP community will be greatly served for decades to come, armed with the knowledge that Loui left no stone unturned to find the best aircraft possible. It absolutely takes everybody to make the ASP work, and we thank Loui and all of the other dedicated individuals working behind the scenes to make our missions a reality.

Loui Staines, senior procurement specialist

SOFRS Corner

Contributed by Vidal Salazar

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

Welcome to FY23. Thank you all for closing out all open flight requests for FY22. The call letter has been distributed for FY23, and we look forward to a new look and feel of the airborne science websites this year.

Flight requests can be made any time in the Science Operations Flight Request System (https://airbornescience. nasa.gov/sofrs), including placeholders for proposals.

If you need help submitting a flight request, please contact Vidal Salazar (vidal.salazar@nasa.gov), Sommer Nichols (sommer.nichols@nasa.gov), Stevie Phothisane (s.s.phothisane@nasa.gov) or SOFRS_curators@airbornescience.nasa.gov.

Calendar of Events

PECORA 22 Conference: Celebrating Landsat
October 24-27, 2023
Denver, CO
https://pecora22.org/

NASA ESI 2022 Solid Earth Team Meeting
November 7-10, 2022
Scripps Seaside Forum, La Jolla, California
Contact: Kevin Reath (kevin.reath@nasa.gov)

ECOSTRESS Team Meeting
November 15-17, 2022
Ventura, California
https://ecostress.jpl.nasa.gov/events/ecostress-science-and-application-team-meeting-fall-2022

TFRSAC 2022 Fall meeting (virtual)
November 29-30, 2022
Contact: Everett Hinkley (ehinkley@fs.fed.us]) or Vince Ambrosia (Vincent.g.ambrosia@nasa.gov)

AGU Fall 2022 Meeting (In person and online)
December 12-16, 2022
Chicago, IL
https://www.agu.org/Fall-Meeting

American Meteorological Society (ASM) 103rd meeting
January 8-12, 2023
Denver, CO
https://annual.ametsoc.org/index.cfm/2023/

AIAA 2023 Science and Technology Forum
January 23-27, 2023
National Harbor, MD
https://www.aiaa.org/SciTech/program

IEEE Aerospace
March 4-11, 2023
Big Sky, MT
https://www.aeroconf.org/

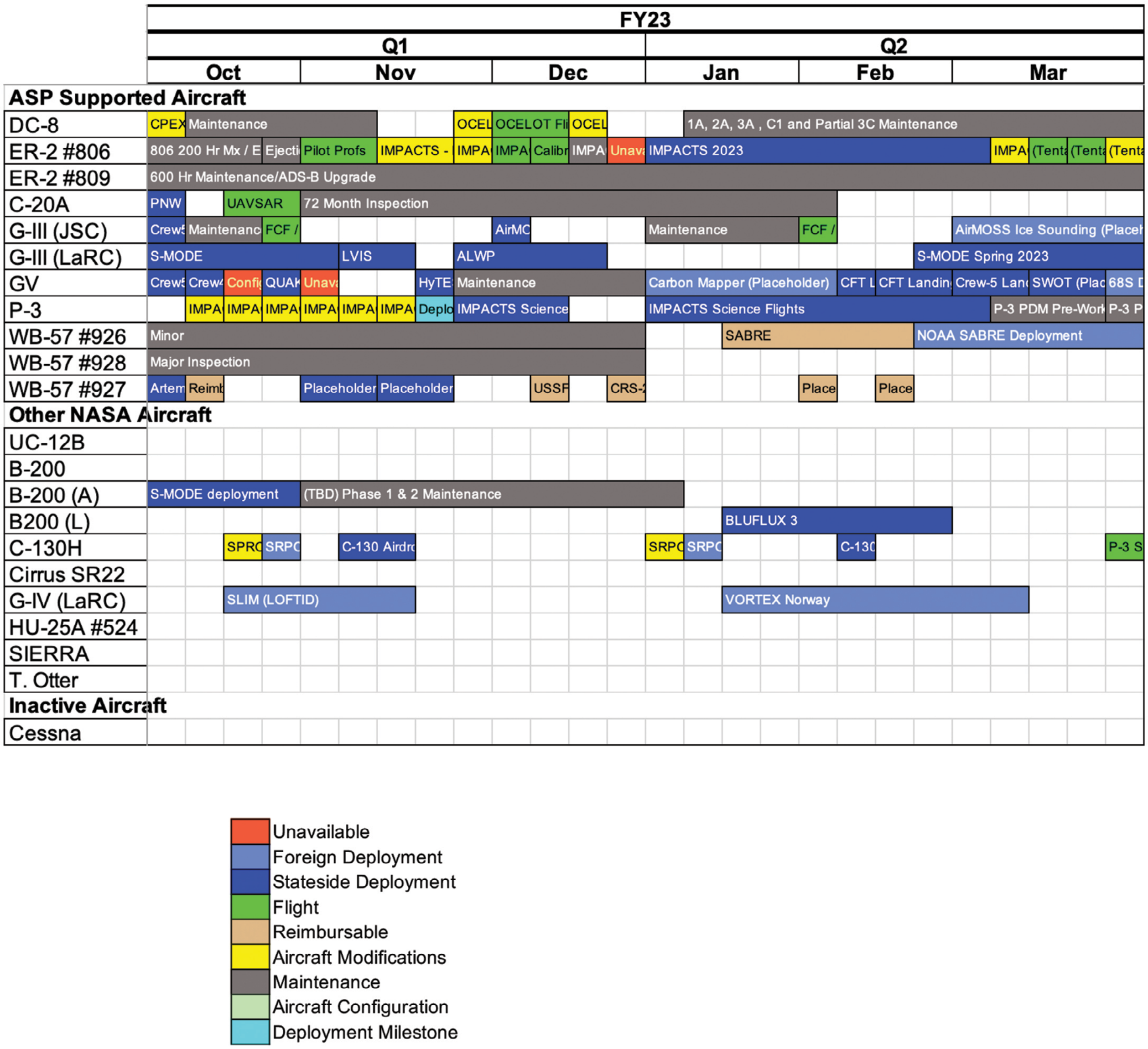
AGU Ocean Visions Summit
April 4-6, 2023
Atlanta, GA
https://www.agu.org/Ocean-Visions-Summit

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

IGARSS 2023
July 16-21, 2023
Pasadena, California
Abstract Submissions Open November 14, 2022
https://2023.ieeeigarss.org/

NASA Airborne Science Program 6 Month Schedule Starting October 2022 *(generated 10/13/2022)*



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	7	2,610	45,000	460	3,000
GV	NASA-JSC	2 nadir ports	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
HU-25A Guardian	NASA-LaRC	1 nadir port, wing hard points, crown probes	6	3,000	42,000	430	2,075
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
WB-57 (2)	NASA-JSC	Nose cone, 12ft of pallets for either 3ft or 6ft pallets, 2 Spearpods, 2 Superpods, 14 Wing Hatch Panels	6.5	8,800	60,000+	410	2,500

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