NASA Responds to Kilauea Eruption with GLISTIN-A

What's Inside

The 2018 eruption of the Kilauea volcano on the Big Island of Hawaii was the largest in nearly 200 years in terms of lava effusion or production. NASA responded quickly to deploy the GLISTEN-A radar on the NASA C-20 in order to improve measurements of lava effusion and to enable improved situational awareness to citizens and partner organizations responding to the rapidly changing disaster. The eruption began May 3 and lasted until August 4, 2018, with lava effusion located some 40 km east of Kilauea caldera along the East Rift Zone (ERZ).

NASA JSC G-III with GLISTIN-A team in Hawaii

One important observation relevant to constraining physical models of the Earth's magmatic system is lava effusion volume with time. This measurement can be achieved through repeat topography maps relative to the pre-eruption topography to create maps of lava flow thickness, which are then summed to measure the extruded lava volume with time. Fortunately, NASA had just the instrument in GLISTIN-A, a dual-antenna, Ka-band SAR, capable of producing single-pass topography maps over 10 km wide swaths. GLISTIN-A is carried in a pod attached to the underside fuselage of the NASA G-III jets flying out of either NASA AFRC or JSC.

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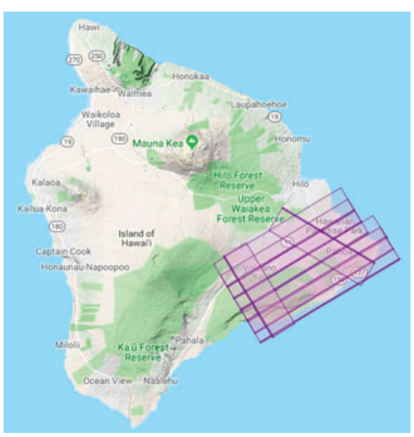
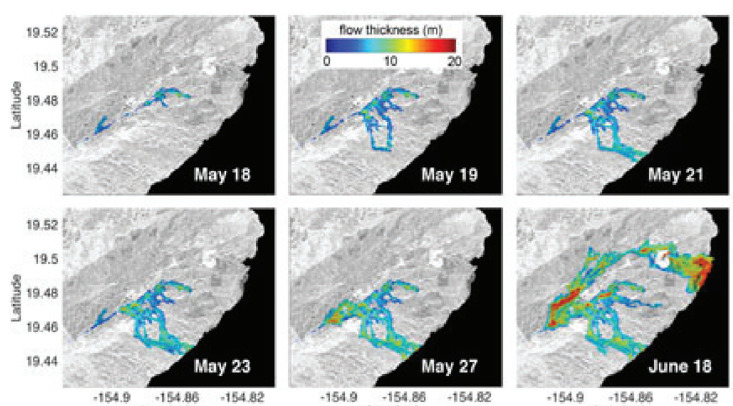


Map of the Island of Hawaii showing the swath coverage of the GLISTIN-A Kilauea eruption deployment flight lines. Each swath is 10 km wide. Multiple swaths are used to generate complete coverage of Kilauea volcano, including the East Rift Zone.



Maps showing computed lava flow thickness maps for the six GLISTIN-A acquisitions during the 2018 Kilauea volcano eruption over the Lower East Rift Zone near the eastern tip of the Island of Hawaii.

2018 NASA Student Airborne Research Program

The tenth annual NASA Student Airborne Research Program (SARP) took place June 17-August 10 at the NASA AFRC and the University of California, Irvine. SARP provides a unique opportunity for rising senior undergraduate students majoring in science, mathematics or engineering fields to participate in a NASA Airborne Science research campaign. SARP's goal is to stimulate interest in NASA's Earth Science research and aid in the recruitment and training of the next generation of scientists and engineers, many of whom had their first hands-on research experience during this program.

The 28 SARP 2018 participants came from 28 different colleges and universities in 20 states. They were competitively selected based on their outstanding academic performance, future career plans, and interest in Earth system science.

All students flew onboard the NASA DC-8, where they assisted in the operation of instruments that sampled and measured atmospheric gases and assessed air quality in the Los Angeles Basin and in California's Central Valley. The DC-8 overflew dairies, oil fields and crops in the San Joaquin Valley in addition to parts of Los Angeles and the Salton Sea at altitudes as low as 1,000 feet to collect data. Students also used ocean and land remote sensing data collected for them over Santa Barbara by the NASA ER-2. In addition to airborne data collection, students took measurements at field sites near Santa Barbara, the Salton Sea, and Sequoia National park.

The final six weeks of the program took place at the University of California Irvine where students analyzed and interpreted data collected aboard the aircraft and in the field. From this data analysis, each student

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Directors' Corner

Welcome to the Fall 2018 ASP newsletter. As always, Randy and I hope you enjoy reading about the program. This year we have flown over 2,700 flight hours for Earth Science, despite having one of our ER-2's out of service. (Each is undergoing a major cockpit modification with upgraded avionics and pilot safety improvements.) Over 700 of those hours have been on commercial aircraft, or as NASA likes to call it, CAS (commercial aircraft services). If you are flying on a commercial aircraft, commercial aircraft for NASA, we want to see your flight tracks on our Asset Tracker - https://go.nasa.gov/2xGBk7y - (POC: Aaron.r.duley@nasa.gov).

For those who do not know, NASA has kicked off a new initiative to better understand CAS and how we can ensure we are using them safely, as well as maximizing efficient and effective aircraft operations. Each Center is already represented in this initiative, but feel free to let Randy and me know your thoughts on CAS and we will ensure they get addressed. No guarantees, but I am also actively engaging the commercial sector to see if we can get further options to meet your requirements, i.e., more FAR part 135 operators with modified aircraft.

Speaking of modified aircraft, both the LaRC G-III and the JSC G-V are in Georgia having nadir ports installed, with first missions planned for early 2019. As you will see in this newsletter, we have been and are very busy. As this is being written, we are flying OMG (on a commercial DC-3), flying a variety of ER-2 missions, preparing for the ORACLES and IceBridge Antarctica missions, as well as re-flying the Kilauea volcano and prepping to support Hurricane Florence damage assessment with the UAVSAR. It takes a lot of effort from a great team to pull all this off, so thank you to all. We hope you stay safe the rest of the year and make sure to enjoy friends and family come holiday time. As always, if you have any feedback about this newsletter or the Program – good or bad – please let Randy and me know.

Bruce Tagg and Randy Albertson
Airborne Science Program

GLISTIN-A *(continued from page 1)*

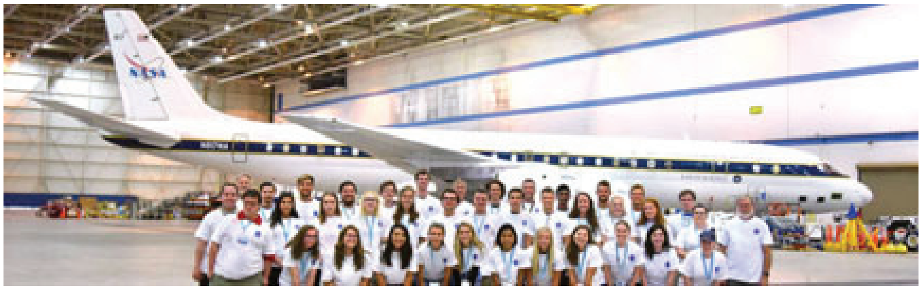
On May 16 GLISTIN-A was deployed to Hawaii. Its first data were acquired mid-day on May 18. The first lava had erupted briefly on May 3 and May 4. The eruption of this thick, viscous lava continued until May 18. Because the initial lava flows were both small in volume and covered relatively small areas due to the lava's high viscosity, it was unclear what the eruption duration might be. On the afternoon of May 18, soon after the initial GLISTIN-A observations, the flow from the fissure system increase dramatically with the arrival of much hotter, lower viscosity magma from beneath the Pu'u' O'o' cone in the middle ERZ. Thus, GLISTIN-A was fortuitous in having its first observations coming early in the eruption, as the lava effusion began in earnest late on May 18 through August 4.

GLISTIN-A acquired 6 acquisitions over one month (May 18, 19, 21, 23,27, June 18). A final set of observations is taking place in September in order to make the final lava flow thickness maps.

Contributed by Paul Lundgren, JPL

The Airborne Science Program newsletter is a biannual publication, appearing each Spring and Fall and is producted by Susan Schoenung (Editor) and Gailynne Bouret (Graphics and Layout), BAER Institute.

SARP 2018 *(continued from page 2)*



2018 SARP Students with the DC-8 at AFRC

developed a research project based on his or her individual area of interest. In addition to the new data collected during the program, students had the opportunity to use data gathered by SARP participants in previous years, as well as data from other NASA aircraft and satellite missions. Four students plan to submit conference abstracts to present the results of their SARP research at a future American Geophysical Union Fall Meeting.

Contributed by Emily Schaller, BAER Institute

In Brief

Upcoming 2018 mission updates

- The NASA P-3 leaves WFF on September 22 for São Tomé for the final ORACLES campaign. ORACLES is measuring the interaction of pollution from biomass burning with weather systems off the west coast of Africa. Major payload components measure aerosols at levels above the clouds. ORACLES will continue through early November.
- The NASA DC-8 leaves AFRC on October 7 for the final Antarctic campaign of Operation Ice Bridge (OIB). This mission will also include early cal/val data collection for the ICESat-2 satellite, which has a launch date of September 15, 2018. The DC-8 will return from South America in late November.
- The final Arctic campaign of OIB will send the P-3 back to Greenland early next year.

ATom Completes Successful EVS Campaign

The return of the NASA DC-8 to AFRC on May 21, 2018 marked the successful completion of the fourth and final Atmospheric Tomography Mission (ATom) deployment under the Earth Venture Suborbital (EVS) program. Immediately after the final flight, the returning team celebrated this great accomplishment with cake and sparkling wine in the B703 hangar. While the deployment was completed successfully, there were three notable differences between the third and fourth deployments — two unplanned and one planned — that presented the ATom team with new challenges during the project's final global survey of the atmosphere.

The first of the anomalies was the result of an aircraft communication system issue, which caused the departure from AFRC to Anchorage, Alaska to be delayed by one day. The planned two-day stopover in Anchorage was shortened by one day in order to get back on the original schedule. The second anomaly occurred due to bad weather on route to Thule, Greenland from Lajes AB, Portugal, which caused the aircrew to divert to Kangerlussuaq. Due to the short runway length at the Kangerlussuaq airport, the aircraft could not take off with sufficient fuel to get back to Anchorage, the next planned stopover location. After an overnight stay in Kangerlussuaq, the team flew to Bangor, Maine, spent the night, and then departed for Anchorage the following day, back on the original schedule.

The one planned difference between the ATom-3 and ATom-4 deployments was that Recife, Brazil replaced Ascension Island as a stopover location due to the continuing runway deterioration at Wideawake Field on Ascension Island. While the decision to use Recife caused somewhat of a last-minute scramble to make all of the necessary arrangements, the stopover in Recife ultimately worked out well.

Over the four deployments, the ATom project accrued 437 flight hours, covering 320,000 km, 675 vertical profile maneuvers, 10 missed approaches, 10 eddy-flux maneuvers, 7 TCCON site over-

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The ACT-America Earth Venture Mission Successfully Completes its Fourth Measurement Campaign

Tracks of B200 (blue) and C130 (red) over the three ACT-America regions (Mid-Atlantic, Mid-West, and South) collecting high-resolution measurements during the Spring 2018 field campaign.

The Atmospheric Carbon and Transport – America (ACT-America) Earth Venture Suborbital 2 (EVS2) team completed their fourth atmospheric measurement campaign in May 2018. The spring field campaign was conducted between April 12 and May 20, 2018, covering the territory shown below. The campaign used two instrumented NASA aircraft to gather atmospheric measurements of greenhouse gases along with other trace gases and standard meteorological variables by operating out of LaRC, Wallops Flight Facility (WFF), Shreveport, Louisiana, and Lincoln, Nebraska. The LaRC B-200 aircraft (carrying in-situ sensors) collected 128.2 hours of data and the WFF C-130 aircraft (carrying in-situ and remote sensors) collected 103.2 hours of data during 26 research missions. These missions occurred over the U.S. South, Mid-West, and Mid-Atlantic regions, and as well as during transit flights between regions. In addition to the numerous level leg flights, 334 quasi-vertical profiles of greenhouse gases and meteorological variables were made using spirals or on route ascents or descents with both the C-130 and B-200.

Daily flight plans were designed based on prevailing meteorological conditions, synoptic scale settings, and source-sink distributions of different atmospheric tracers in the three regions, and the research flight days were classified into frontal, fair weather, and Gulf inflow; some days were hybrids of these. Additionally, during five fair weather days, underflights of the OCO-2 (Orbiting Carbon Observatory-2) satellite were carried out to investigate the sensitivity of CO2-column measurements from the OCO-2 to lower tropospheric CO2 variability. Airborne observations also sampled the atmospheric signatures of CO2 and CH4 fluxes around oil and gas extraction regions, urban centers, agricultural lands, and forests. We studied the distribution of greenhouse gases around several storms, often referred to as mid-latitude cyclones. In particular, front-relevant greenhouse gas structures in both boundary layer and lower free troposphere were also examined for two to three days in a row so that the impact of frontal propagation and associated greenhouse gas transport mechanisms could be revealed. The spring campaign included several sets of data that are unique to the ACT-America mission including: flying across the same stationary frontal boundary more than five times within a week over the Mid-Atlantic region, and flying across varying "greening" over both the South and Mid-Atlantic regions in which spring had arrived in the South and Mid-Atlantic, but not the Mid-West. The longest ACT-America flight to date lasted 9.2 hours and crossed 10 states between

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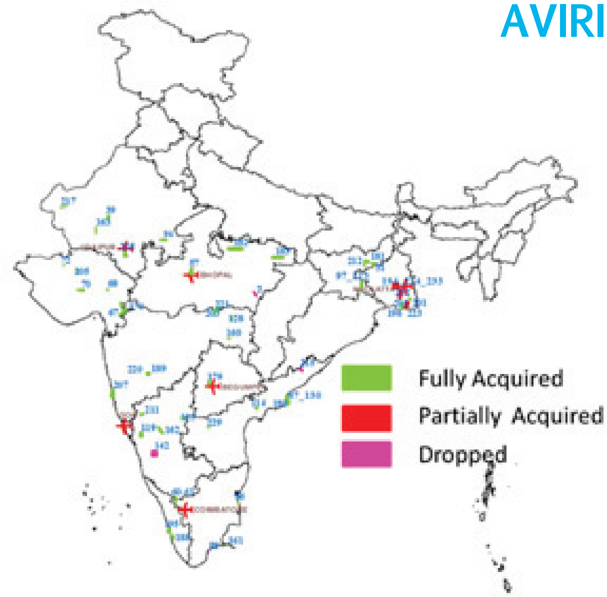
C-130 and B-200 Deployment teams in Lincoln, Nebraska, for ACT-America Spring 2018 mission.

AVIRIS – NextGen Travels Abroad



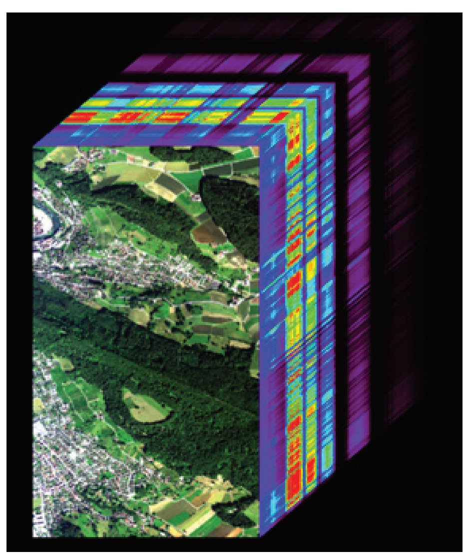
The JPL AVIRIS – NextGen (AVIRIS-ng) instrument has been globe-trotting in collaborative efforts to make advanced spectrometric measurements of Earth vegetation, minerals and urban landscapes. The instrument was in India from late February to mid-May and in Europe in July, before joining the ABoVE mission in August in Canada and Alaska.

In India, AVIRIS-ng flew again (as in 2016) on an Indian B200 aircraft in collaboration with Indian Space Research Organization (ISRO) activity, implemented by the Space Application Center (SAC). The objective of the airborne campaigns is to provide the required precursor ground truth data and science and application research demonstrations for present and future space imaging spectrometer missions. In addition, the collaboration provides opportunity for joint development of science models, algorithms, atmospheric corrections and new avenues of cooperation. While in India, the "Phase-2A" mission flew out of 6 airbases, acquiring data over 48 out of 52 proposed sites, covering a total of 15,634 square km. Locations are shown on the map below. For "Phase-2B" AVIRIS-ng will return to India in November 2018.

In June, AVIRIS-ng traveled to Switzerland on a Dynamic Aviation B200 for a collaborative mission with the European Space Agency (ESA) and the University of Zurich (UZH). Specifically, AVIRIS-ng went to Europe to support Calibration and Validation of the ESA Sentinel 3-B satellite. The airborne campaign was intentionally coincident with the commissioning phase of Sentinel-3 B, which was reprogrammed for single orbits and to have 44 additional channels to support the scientific objectives of the campaign.

Other objectives of the 1-month stay were to support advanced ecosystem science and to prepare data for the upcoming ESA FLEX mission and the potential Copernicus CHIME mission.

A total of 86 flight hours were flown over 24 study sites in Germany, Italy and Switzerland. Coordination between UZH, ESA and NASA/JPL allowed for a successful deployment. Agreement between NASA/JPL and UZH allows for future campaigns in 2019-2022 with other JPL airborne imaging spectrometers from UV to TIR, including the Portable Remote Imaging Spectrometer (PRISM) and Hyperspectral Thermal Emissions Spectrometer (HyTES).



AVIRIS-NG image cube showing full spectral range measurements at the Laegern Test Site in Switzerland.

Contributed by Rob Green and Ian McCubbin, JPL

ACT-America *(continued from page 4)*

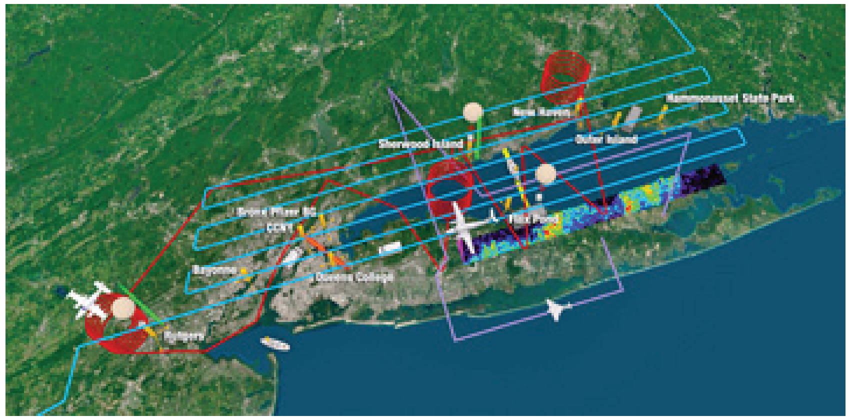
South Dakota and the Gulf of Mexico. All the measurements collected during the campaign will be used to improve numerical models of greenhouse gas fluxes and atmospheric transport, one of the most compelling issues in carbon cycle science.

ACT-America will conclude with its fifth campaign in the summer of 2019. Dr. Ken Davis from Pennsylvania State University (PSU) is the principal investigator for this mission. ACT-America includes participation from NASA scientists and engineers at LaRC and WFF, as well as scientists from PSU, Colorado State University, University of Colorado, Stanford University, Oklahoma University, NOAA, Oak Ridge National Laboratory (ORNL), Clark University, the German Aerospace Center (DLR), and Harris Corporation.

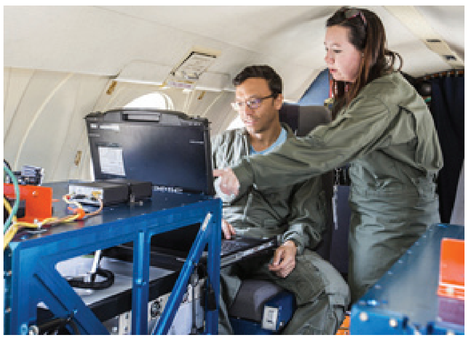
Contributed by Mike Obland (NASA LaRC)

Long Island Campaign Nearing Completion

The summer 2018 Long Island Sound Tropospheric Ozone Study (LISTOS) is nearing a successful conclusion. LISTOS, designed to improve the understanding and forecasting of poor air quality associated with high surface ozone concentrations in the Long Island



Flight tracks of various aircraft during LISTOS. Blue tracks are a dipction of those flown by the B-200. Red spirals were flown by a UMD Cessna. Green beams are ground-based ozone lidars, orange tripods are Pandora remote sensing stations, and white balloons indicate the ozone sonde locations.



NASA Goddard's Peter Pantina, left, and Langley's Laura Judd make final checks of the GEO-TASO instrument on the HU-25A aircraft before a flight.

Sound region, was conducted with several federal, regional, state, local, and university partners (http://www.nescaum.org/documents/listos). NASA's involvement included extensive airborne remote sensing measurements, deployment and operation of two ground-based ozone lidar systems, ozone sonde launches, and support of a ground-based network of

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ATom *(continued from page 3)*

flights and 3 over-flights of Antarctica. "ATom was intended to probe the most remote parts of the atmosphere, to detect the subtle influence of pollution in the farthest reaches of the globe," said lead PI Steven Wofsy. "We were astonished to find that human-caused pollution was anything but subtle in very remote places, especially the Arctic and Antarctic, and the tropical Atlantic. ATom showed that the most remote places in the atmosphere are commonly observed to be severely impacted by diverse sources of pollution."

Michael J. Prather, the Deputy Lead PI, noted: "In ATom-4's first 3 flights (PMD-equator-PMD-ANC-KOA) we passed through extensive air masses with strong, distinct chemical signatures of wildfires, industrial pollution, and stratospheric intrusions. These air masses were often folded and had sharp boundaries with what could be described as clean maritime air above and below. They were identifiable over thousands of km in the horizontal and 5 km (nearly a full-scale height) in the vertical."

Contributed by Dave Jordan, ARC and Steve Wofsy, Harvard

The ATom-4 deployment team and the DC-8 returns to AFRC on May 21, 2018.

SOFRS Corner

SOFRS Website:
https://airbornescience.nasa.gov/sofr

We are happy to present the first edition of the Science Operations Flight Request (SOFRS) corner, a space for the community to learn the latest and greatest on all things SOFRS. The system is a communication tool to make sure scientists, aircraft manager, funding sources and HQ are all on the same page. The reports and summaries it generates are important tools for ASP management to report to HQ about the wonderful job that you are all doing supporting these projects around the world.

As you all know, SOFRS maintains and manages a database of sensors and aircraft assets while facilitating the tracking and allocation of these ASP resources to the scientific community. The SOFRS curators are continually improving the system to help of you, the ASP community, through occasional software fixes and new features that are aimed at addressing enhancements and/or issues reported by the users.

View My Current Summary

After you login to the SOFRS system, on the left hand side menu, you will see a "View my Current Summary." This summary will give you a full view of all the flight requests that you are associated with filtered by fiscal year. You have the option of downloading this summary as an excel spreadsheet.

Actual Complete Box

Those of you completing and closing flight requests, don't forget that after you enter all your "cost actuals", you need to click the box "Actual is complete" to close the flight request and avoid all those pesky automatic emails.

SOFRS curators want to hear from users to learn how we can build a better tool for the ASP community. You can always email us at SOFRS_curators@airbornescience.gov.

Contributed by Vidal Salazar, ARC

LISTOS *(continued from page 6)*

NASA-developed Pandora remote sensing instruments. Partners provided continuous forecasting and analysis support, airborne in-situ measurements, and extensive measurements from ground sites, two mobile labs, and two ships.

A goal of NASA's involvement in LISTOS is improving the ability of the public to use air quality information from satellites, in particular the upcoming measurements from the Tropospheric Emissions: Monitoring Pollution (TEMPO) mission. The NASA LISTOS flights used two instruments that are airborne simulators for TEMPO: the GEO-CAPE Airborne Simulator (GCAS) and the Geostationary Trace Gas and Aerosol Sensor Optimization (GeoTASO). Funding from NASA's GEO-CAPE Mission Study supported the LISTOS flights as well as flights during previous summer campaigns in a variety of different locations. A unique aspect of the LISTOS campaign was the ability to make measurements through the entire summer. By basing from Langley Research Center and having flexibility to use either GCAS or GeoTASO on multiple aircraft, the team was able to conduct 30 flights totaling 140 flight hours during 15 sampling days from mid-June through mid-September while adapting to other scheduled usage of LaRC aircraft. This flexibility allowed a wide range of weather conditions to be sampled through the summer, including classic heat waves resulting in

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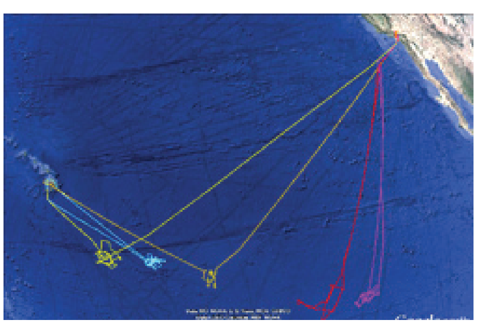
HIWC-II Mission tests radar system to detect ice ahead

JSC G-V and aircraft team

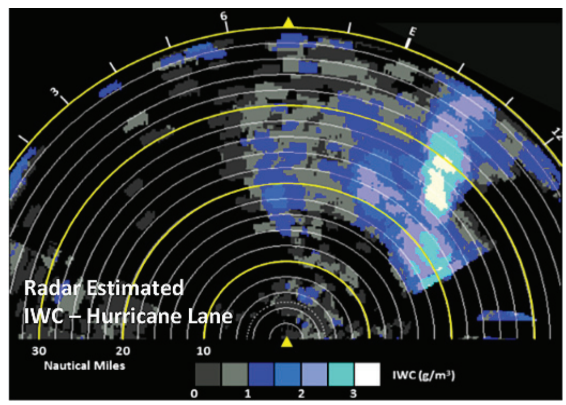
High concentrations of ice particles have been causing modern jet engines to malfunction leading to hazardous flight conditions and adding millions of dollars of expense to commercial airline operations. In August of 2018, researchers from NASA LaRC installed a radar processing system onto the NASA Armstrong DC-8 to test a new NASA-developed algorithm that promises to provide remote detection and ice concentration estimates out to 60-80 nautical miles ahead of the aircraft (approx. 10 minutes warning). In order to validate the radar's performance NASA Glenn researchers installed a myriad of meteorological probes and sensors that characterize the atmosphere and hydrometeor environment through which the aircraft flies.

The High Ice Water Concentration (HIWC) flight campaign consisted of 50 hrs of flight into and above tropical storms and other mesoscale convective storms (MCS). The deployment began in Florida looking at MCS in the Gulf of Mexico while waiting for tropical waves to develop in the Atlantic. After more than a week of inactivity in the Atlantic, with no potential activity in the 10-day forecast, and with several tropical storms churning in the eastern Pacific, the deployment moved back to Palmdale, CA and followed the tropical wave that became Hurricane Lane. Flights through Hurricane Lane were of greatest interest since they began while the storm was still a tropical depression and followed its evolution daily (5 of 6 continuous days) as it progressed into a Cat II/III/IV Hurricane. Each day we were able to depend upon this powerful storm to generate high ice concentrations over large areas – indicative of the conditions experienced by commercial operations and providing us ample opportunities and widely varying conditions in which to test and verify the radar algorithm's performance.



HIWC flight tracks over Hurricane Lane

"The radar algorithm out-performed our estimates, providing consistently accurate estimates of the ice water concentrations (IWC) out to ranges of 60 nautical miles – a limit only set by our processing capability. I don't know how much further we can accurately estimate these conditions but we do expect to determine that limit during post-flight analysis." said Steven Harrah (NASA Langley) the Principal Investigator for the flight campaign and HIWC Radar PI. "The ice concentrations predicted by the NASA algorithm agreed well with those measured by our meteorological instruments. Using this new algorithm, the radar was able to provide a 3D assessment of the ice field associated with the storm, accurately predicting locations and levels of increasing and decreasing ice concentrations, that were then corroborated by our meteorological probes as we flew that portion of the storm." said Tom Ratvasky (NASA Glenn) Co-Investigator for the flight campaign and HIWC Characterization PI. The NASA pilots liked the Radar-IWC display/info well enough that they were able to fly the aircraft into and around High Ice Water Concentration (HIWC), noting they could reliably count on the radar predictions and could vector the aircraft as well as descend/ascend to enable/avoid an encounter.



Radar Estimated IceWater Content - Hurrican Lane

This flight campaign was funded by the FAA, who will use these results along with those from previous flight campaigns to develop standards for radar-based HIWC detection and flight avoidance procedures. RTCA, radar manufacturers, and aircraft manufactures followed these developments and are planning a workshop this fall to learn more details regarding this algorithm and the certification standards that it would support.

Contributed by Steven Harrah, LaRC

DopplerScatt makes significant contributions to ocean current measurements

NASA 801 taking off from New Orleans' Louis Armstrong Airport with DopplerScatt onboard (conical radome mounted in the nadir-looking port of the King Air) for the science flight, March 26, 2018.

JPL's DopplerScatt instrument, designed to measure ocean surface currents, has graduated from IIP to AITT and now collaborative science measurements. Two missions have been carried out in 2018, one in the Gulf of Mexico in March, and the second in the Pacific in August. In the first mission, JPL, in collaboration with Chevron, was benchmarking DopplerScatt's surface current measurements against ground-truth data from Chevron. DopplerScatt conducted survey flights Mar 23-29 over the Gulf of Mexico, while the Loop Current is active in the far north of the Gulf near New Orleans. The flights were conducted over areas where Chevron already measures surface currents with assets such as drifters, acoustic Doppler current profilers (ADCPs), and ROCIS (an airborne optical imager). The collaboration and deployment specifics were worked out efficiently and DopplerScatt team members (Alex Wineteer, Noppasin Niamsuwan and Fabien Nicaise) deployed to the field on March 23rd and executed 4 flights between March 24th and March 27th.

During the deployment DopplerScatt trialed a new real-time processor (designed and implemented by Tamas Gal) and real-time map display (implemented by DopplerScatt intern Narek Boghozian) as part of the AITT milestone verification. These new features enabled situational awareness of operators and faster quick-look ground post-processing.

DopplerScatt surface current estimates are being compared to the in-situ data provided by Chevron as well as the ROCIS sensor data. The ROCIS data is of particular interest, as it is the first comparison of current measurements at the very surface of the water (top few millimeters as opposed to slightly deeper currents measured by other sensors). Strong loop currents can pose safety risks to offshore operations. DopplerScatt's estimates of surface currents could be used to inform offshore operations. This deployment was a huge team effort including teams from AFRC, Chevron and DopplerScatt/JPL.

Top Left: DopplerScatt summer student, Vivian Pazmany, ready for science flight. Top right: NASA 801 pilots Hernan Posada and Scott Howe with DopplerScatt operator, Alex Wineteer. Bottom: DopplerScatt team; (left to right) Scott Howe, Fabien Nicaise, Mario Soto, Leroy Marsh, John Collins, Alex Wineteer, and Herman Posada with the NASA 801 at Norman Y. Mineta International Airport, San Jose, CA.

For the August mission, the DopplerScatt team collaborated with Florida State University, University of Washington and Scripps Institute of Oceanography, in a deployment to the Pacific (South-West of the San Francisco Bay) to observe submesoscale processes. DopplerScatt conducted survey flights August 20-24 over the area where novel ultra-thin drifters were deployed by the FSU and UW from the research vessel Shana Rae. This deployment was organized by Ernesto Rodriguez who during the deployment coordinated all data collections.

DopplerScatt team members and a summer student deployed in the field on August 20th and executed 5 flights between August 20th and August 24th with flying 2 sorties on Friday the 24th. During the deployment DopplerScatt collected data continuously during the flights. The winds

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Goddard's GREX Participates in GRAINEX Mission

The Great Plains Irrigation Experiment (GRAINEX) is an NSF funded project with the goals of better understanding the influence of irrigation on land-atmosphere interactions, the planetary boundary layer and weather events over SE Nebraska. During the mission, which took place in July, GRAINEX measured meteorology, surface fluxes, soil moisture and temperature at nearly 100 stations distributed across a 100x100 km domain, where there is a sharp transition zone between irrigated (west) and non-irrigated (east) fields.

Map of GRAINEX 100x100 km domain (white box) and flight lines

GREX mounted in NASA Glenn Twin Otter. Science flights were conducted with the cargo door off.

Goddard's RF Explorer (GREX) instrument flew on NASA Glenn's Twin Otter to provide high-resolution wide-area soil moisture transects across this transition zone that cannot be obtained any other way, complementing NSF's ground measurements with remote sensing.

GREX observed V-polarized L-band microwave brightness temperature—the same as SMAP. These are being converted to soil moisture using the SMAP algorithm. Radio frequency interference data will also be characterized for future low-frequency missions.

ASA Glenn provided pilots plus support for instrument installation, airworthiness reviews, and aircraft maintenance in the field. Goddard provided installation engineering and fabrication as well as instrument operators and flight line planning. Operations were based out of Lincoln, NE July 16-27. Flights were conducted at 1000' AGL in order to obtain a GREX footprint size smaller than a quarter-section farm field. Conditions were favorable, and the deployment went well.

GRAINEX is a collaboration among UCAR, Western Kentucky Univ., Univ. of Alabama Huntsville, and Univ. of Colorado.

Contributed by Ed Kim, GSFC

LISTOS *(continued from page 7)*

unhealthy ozone throughout the region, other weather patterns resulting in more localized high ozone, and relatively clean background conditions.

Phase 1 of LISTOS, during June, used GeoTASO on the LaRC HU-25A Guardian aircraft. In addition to mapping the LISTOS domain, the range of the Guardian allowed these flights to also map pollutants in the Baltimore area in support of NASA's OWLETS-2 air quality campaign (PI – Hanisco). Phase 2, July through early September, used GCAS on the LaRC B-200 King Air aircraft. In addition to GCAS, the capability of the B-200 also allowed inclusion of the new High Altitude Lidar Observatory (HALO) instrument (IIP project, PI – Nehrir) to provide information on aerosol vertical distribution and the mixing depth of pollutants. This information, critical for accurately inferring surface concentrations from the satellite remote sensing measurements, is also especially helpful for analysis of air quality events in coastal regions such as Long Island Sound. Phase 3 of LISTOS, to complete by the end of September, will use the B-200 with GeoTASO and a new Multi-axis Optical Airborne Tracker (MOAT). MOAT will allow improved GeoTASO zenith measurements, providing data very useful for ongoing testing of new TEMPO algorithms for retrieving ozone vertical profile in the troposphere.

LaRC participants in the airborne measurements include Jay Al-Saadi (program science, mission science), Laura Judd (deputy mission science, data operations/processing/analysis), Amin Nehrir (HALO science), and Jim Collins (HALO engineering). GSFC participants include Scott Janz (GCAS and GeoTASO PI), Matt Kowalewski (GCAS and MOAT lead engineer), Peter Pantina (GCAS/GeoTASO operations), and Sam Xiong (GCAS/GeoTASO operations). Additional information is available at: https://www-air.larc.nasa.gov/missions/listos/index.html

Contributed by Jay Al-Saadi, LaRC

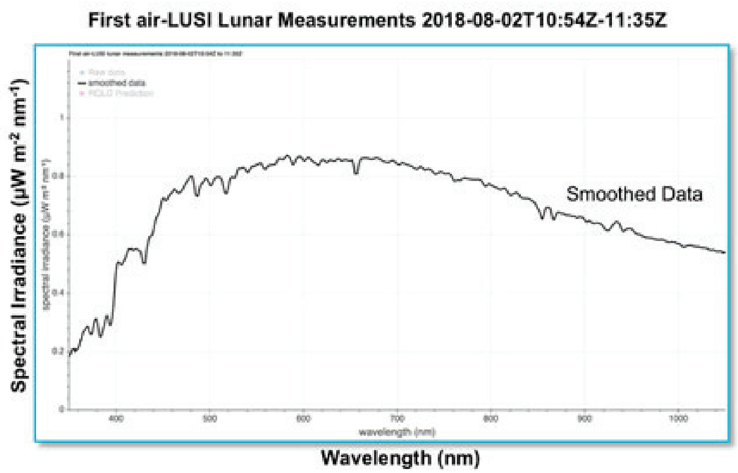
AITT Project Air-LUSI Carries out first successful test flight

The objective of airborne LUnar Spectral Irradiance (air-LUSI) mission is to provide NASA a capability to measure exo-atmospheric lunar spectral irradiance with unprecedented accuracy. Careful characterization of the Moon from above the atmosphere will make it a stable and consistent SI-traceable absolute calibration reference. This could revolutionize lunar calibration for some Earth observing

IRIS telescope on ARTEMIS mount in ER-2 wing pod tail

satellites and would be especially beneficial to ocean color missions, such as the upcoming PACE and JPSS (VIIRS) missions, and retrospectively for the SeaWiFS, EOS (MODIS), and S-NPP (VIIRS) data records.

Air-LUSI approaches this characterization by taking lunar spectral irradiance measurements at high-altitude on the ER-2 aircraft. This is accomplished with a non-imaging telescope to collect moonlight, which is passed to a NIST-calibrated spectrometer (called the IRradiance Instrument Subsystem or IRIS) via fiber optics. The spectrometer and an on-board validation reference are hermetically sealed in an enclosure made of a two solid blocks of aluminum, keeping the spectrometer and reference at constant sea-level pressure and 20°C during the high altitude flight. The Autonomous, Robotic TElescope Mount Instrument Subsystem (ARTEMIS) keeps the telescope pointed at



the Moon using a camera to track the sky in front of the telescope.

After a year of design and development, air-LUSI executed its first test flight at AFRC in Palmdale, CA Aug 1st and 2nd between the hours of 0300 and 0500. The results exceed expectations. During its test flights, the ARTEMIS subsystem kept the IRIS telescope locked onto the Moon to within 0.1° on average and the IRIS enclosure kept the spectrometer and validation reference solidly at sea-level pressure and 20°C. The measurements recorded during these flights showed very high signal-to-noise ratio and sensitivity to the lunar spectrum. The air-LUSI team is now analyzing this and the engineering data and preparing for their demonstration flights early in 2019.

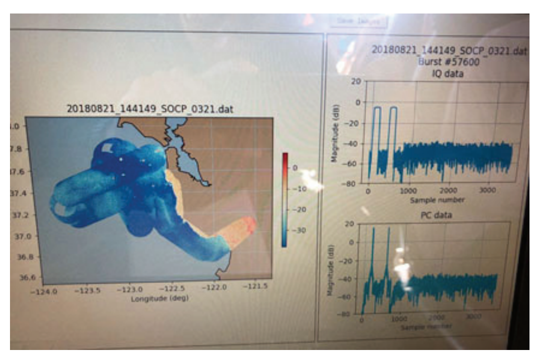
Air-LUSI is an Airborne Instrument Technology Transition (AITT) project. The goal of the AITT program is to mature airborne instruments from the demonstration phase to science-capable instruments.

Contributed by Kevin Turpie

DopplerScatt *(continued from page 9)*

were low (1-3 m/s) until August 24th when they picked up to ~ 6m/s in the afternoon. DopplerScatt surface current estimates will now be compared to the in-situ data provided by the FSU and UW. This deployment was a team effort including teams from AFRC, FSU, UW, SIO and DopplerScatt/JPL.

Contributed by Dragana Perkovic-Martin, JPL



Real-time display post flight, August 21. Left side of screen displays a map image of the overflow area overlaid with DopplerScatt power data. Right side of screen shows range line plots used as diagnostic of the transmit peak power.

Aircraft News

JSC G-V Update

JSC G-V with Aircraft Team

The JSC team made substantial strides with the Gulfstream V (G-V) aircraft over the summer with all efforts leading to the first science mission in March 2019. First and foremost, the maintenance team faced significant challenges in 2018 will all of the 16-year major maintenance coming due at the same time as the aircraft was scheduled to be modified with nadir portals. This heavy maintenance included removal of the engines to inspect the mounts, tear down and reassembly of the landing gear, internal inspections of the wing and tail structure including removal of the wing leading edges, comprehensive below floor inspections from nose to tail, wing-to-body inspections, and more. The team "knocked it out of the park." They were able to complete all maintenance required through the end of January 2019 by the beginning of August: the jet will roll out of the nadir portal modification ready to support science missions. The aircraft flew its Functional Check Flight (FCF) cleanly following this maintenance activity without a single squawk.

In the Spring newsletter, it was noted that Avenger Aerospace, partnered with the Phoenix Air, had been awarded the G-V nadir portal contract. Over the summer all schedule and technical milestones have been met as the project passed the Critical Design Review on July 18. The aircraft will be delivered to Phoenix Air on September 4 to begin the nadir portal installation with a completion date of January 25 2019. During the modification two large, square "ring frame adapters" will be installed in the forward cabin capable of supporting a wide array of airborne science instruments, not just windows. The ring frame adapters are structural in that 350 pounds of equipment can be bolted directly to each portal, and this capability is already being put to good use. The engineering team has been working closely with the G-V's first science customer, using the portals to integrate a payload for the SWOT calibration/validation pilot program, scheduled to be flown in early 2019. The JSC engineering team has been working closely with other payload customers as well, and it appears that 2019 will be a busy year for the aircraft. To discuss schedule, payload integration, and flying on the G-V, contact Derek Rutovic (mihailo.rutovic-1@nasa.gov, 832-205-3854) to start a conversation. Additional information on the G-V modifications can be found at the following website, https://jsc-aircraft-ops.jsc.nasa.gov/gulfstream-gv.html#aircraftspecifications.

Contributed by Derek Rutovic, JSC

New Langley G-III getting ready for science

The Research Services Directorate (RSD) at NASA Langley Research Center, is having an ex-U.S. Air Force C-20B Gulfstream III aircraft modified for NASA Science and Aeronautics research. The G-III aircraft will replace NASA Langley's existing Dassault HU-25A Guardian aircraft for airborne science as soon as practical. An engine hush kit has already been installed, enabling the G-III aircraft to be Stage III noise compliant. This modification allows the aircraft to deploy nationwide and worldwide without requiring engine noise waivers. In addition, two nadir portals are being installed under contract. The nadir portals (each 18.16 in. x 18.16 in. with external shutters) will allow the aircraft to install Earth science sensors, as is currently possible with the Center's two B-200 King Air aircraft and the HU-25A aircraft. The aircraft can be equipped with pressure domes over the

NASA C-20B Gulfstream III aircraft, NASA 520, shown in the NASA Langley Flight Research Hangar prior to installation of the research modifications

Aircraft News *(continued from page 11)*

portals such that instruments can be flown open to the atmosphere. A total of six Researcher Interface Panels are planned for the passenger cabin, which will accommodate up to ten researchers. The research system will also accommodate the NASA Airborne Science Data and Telemetry (NASDAT) system. The G-III aircraft has an advertised range of 3750 n.mi. versus 1800 n.mi. for the HU-25A aircraft. The expected duration will increase from 4.5 hr to about 7.5 hr, and the realistic mission altitude will increase to 45,000 ft from 36,000 ft. Discussions with researchers at NASA LaRC, NASA GFRC and The Johns Hopkins University are underway regarding installation of research systems in the summer of 2019. The goal is to have the LaRC G-III aircraft ready for research at LaRC in the spring of 2019. The FAA N-number selected for this aircraft is N520NA and the call sign will be NASA 520. To discuss schedule, payload integration, and flying on the LaRC G-III, contact Bruce Fisher, (757) 864-3862, bruce.d.fisher@nasa.gov.

Contributed by Bruce Fisher, LaRC

SIERRA-B UAS Completes Flight Qualifications

SIERRA-B, a 500 lb Category-3 UAS operated by Ames Research Center, has completed 15 flights and 24 hours of flight operations. The UAS has completed flight qualification and is expected to be ready to begin supporting science next month. SIERRA-B will provide (a) low-altitude and slow flight capabilities that enhance in-situ air sampling and remote sensing data collection, (b) safe access to remote or dangerous terrain unsuitable for manned platforms, (c) an airborne platform for the development and testing of various autonomous instrument systems, and (d) an airborne platform that will be capable of extensive modifications to support mission objectives without an FAA review because of it's modular design.

Two aircraft were transferred to NASA by the NRL in 2006 and the first one operated through 2013. The new SIERRA-B has been modified with an elongated fuselage and nadir port, and decreased wing dihedral for improved stability. The platform can carry up to 100 lbs of science payload and is expected to operate up to an altitude of 12,000 ft. The payload nose fairing is completely removable and can be customized depending on payload requirements. The original aircraft carried passive imagers, in situ gas analyzers, and active radar and laser based systems. This updated version is designed to carry similar payloads.

Work has begun on the integration design for a synthetic aperture radar (SAR) being developed by SRI of Menlo Park under an Earth Science Technology Office (ESTO) Instrument Incubator Program (IIP) contract. In addition, NASA's Goddard Space Flight Center has developed a new Search and Rescue beacon receiver that can be tested on SIERRA-B.

Contributed by Sally Cahill, ARC

SIERRA-B in flight at Crow's Landing, California

Upcoming Events

- Alaska UAS Interest Group
  September 25-27, 2018; Anchorage, Alaska
  http://uasalaska.org/
- ForestSAT 2018
  October 2-5, 2018; College Park, MD
  http://forestsat2018.forestsat.com/forestsat-2018
- Precipitation Measurement Missions (PMM) Science Team Meeting
  October 8-12, 2018; Phoenix, AZ
  PMM.nasa.gov
- SMAP Cal/Val Workshop #9
  October 22-23; Washington, DC
  SMAP.jpl.nasa.gov
- 30th TFRSAC - Fall meeting
  October 24, 2018; National Interagency Fire Center, Boise, ID
  Contact: Everett Hinkley [ehinkley@fs.fed.us]
  or Vince Ambrosia
  [vincent.g.ambrosia@nasa.gov]
- Unmanned Systems Canada
  October 30-November 1, 2018; Vancouver, Canada
  www.unmannedsystems.ca
- ATom Science Team Meeting
  November 13-15, 2018; NCAR, Boulder, Colorado
  https://espo.nasa.gov/atom/content/2018_ATom_STM
- 20th Anniversary UAS TAAC
  December 4-6, 2018; Santa Ana Pueblo, NW
  https://taac.nmsu.edu/
- AGU Fall 2018 Meeting
  December 10-14, 2018; Washington, DC
  https://fallmeeting.agu.org/2018/
  REGISTRATION and HOUSING OPEN

Continued on page 14

Upcoming Events
(continued from page 12)

- American Meteorological Society 2019 Annual Meeting
  January 6-10, 2019; Phoenix, AZ
  https://annual.ametsoc.org/index.cfm/2019/
- AIAA SciTech Forum
  January 7-11, 2019; San Diego, CA
  https://scitech.aiaa.org/Register/
- ICESAT-2 Newcomers meeting, Jan. 30
  Program for Arctic Regional Climate Assessment (PARCA) meeting, Jan. 31
  OIB Science Team Meeting, Feb. 1
  NASA GSFC; contact Brooke Medley, brooke.c.medley@nasa.gov
- 2019 Aquatic Sciences meeting
  February 24 – March 1, 2019; San Juan, Puerto Rico, USA
  https://aslo.org/page/aslo-2019-aquatic-sciences-meeting
- 40th IEEE Aerospace Conference
  March 2-9, 2019; Big Sky Montana
  https://www.aeroconf.org/
- 5th ABoVE Science Team Meeting
  April 1-4, 2019; LaJolla, CA
  ABoVE.jpl.nasa.gov

Call for Content

Working on something interesting, or have an idea for a story? Please let us know, we'd love to put it into print.

Contact Susan Schoenung (650/329-0845, susan.m.schoenung@nasa.gov) or Matt Fladeland (650/604-3325, matthew.m.fladeland@nasa.gov).

Airborne Science Program and Center 2018 Awards

The following awards have been presented to NASA personnel for 2018. The ASP Awards Board consisted of Randy Albertson (Chair), Matt Fladeland, Mike Cropper and Chuck Irving. Chris Scofield observed and recorded decisions and actions and kept the chair on track. It is the Board's opinion that Dr. Pfister's contributions as a meteorologist to some two-dozen major airborne science campaigns over 30 years, as well as supporting ER-2 ops during the time the ER-2s were based at ARC, warrants the Program's special thanks and recognition.

NSRC, Outstanding Achievement
Steven Schill and Ryan Bennett

Steve Schill (right) with Randy Albertson, Deputy Director of Airborne Science Program

Steve Schill, Instrumentation Engineer. For excellent performance in engineering, showing leadership and continually looking for ways to improve the suite of facility instrumentation, quickly adapting to work instrumentation across a number of platforms.

Ryan Bennett (left) with Randy Albertson

Joseph Ryan Bennett, Data Manager. For excellent performance in data quality control, showing incredible dedication and attention to detail

Continued on page 15

WFF, Outstanding Achievement
Linda Thompson

Linda Thompson with Gerrit Everson, Chief of Flight Operations at WFF

Linda Thompson, Project Manager. For support of ACT-America Campaign and N436 C-130 activation.

WFF, Sustained Excellence
Barbara Justis

Barbara Justis, Project Manager. Sustained Excellence in support of ASP Commercial Aircraft Services and ASP Flight Operations.

Barbara Justis with Gerrit Everson

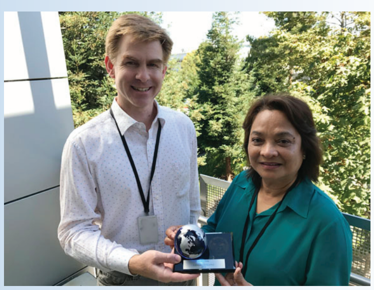
AFRC, Sustained Excellence
Kirk Caldwell

Kirk Caldwell (Center) with Randy Albertson (Left) and Glenn Graham, Director for Safety and Mission Assurance at AFRC (Right).

Kirk Caldwell, System Safety Engineer. For sustained excellence in Airborne Science Platform System Safety Analysis and Mitigation Compliance.

ARC, Sustained Excellence
Evelyn Perez

Evelyn Perez, Financial Administration. In recognition of sustained and successful support of the Earth Science Project Office (ESPO) and the Airborne Science Program (ASP).



Evelyn Perez (Right) with Ryan Spackman, Chief, Earth Science Division, ARC

Continued on page 16

ASP Awards *(continued from page 14)*

Career Sustained Excellence

Leonhard Pfister

Lenny Pfister (Right) with Ryan Spackman

Leonhard Pfister, Research Scientist. In recognition of sustained and successful support of Airborne Science Program's missions in the disciplines of forecasting and flight planning.

ARC, Sustained Excellence

Sommer Beddingfield Nicholas

Sommer Nicholas, Project Logistics and Science Operations Flight Request System (SOFRS) Administration. In recognition of sustained and successful support of the Earth Science Project Office (ESPO) and the Airborne Science Program (ASP).

Sommer Nicholas with Ryan Spackman

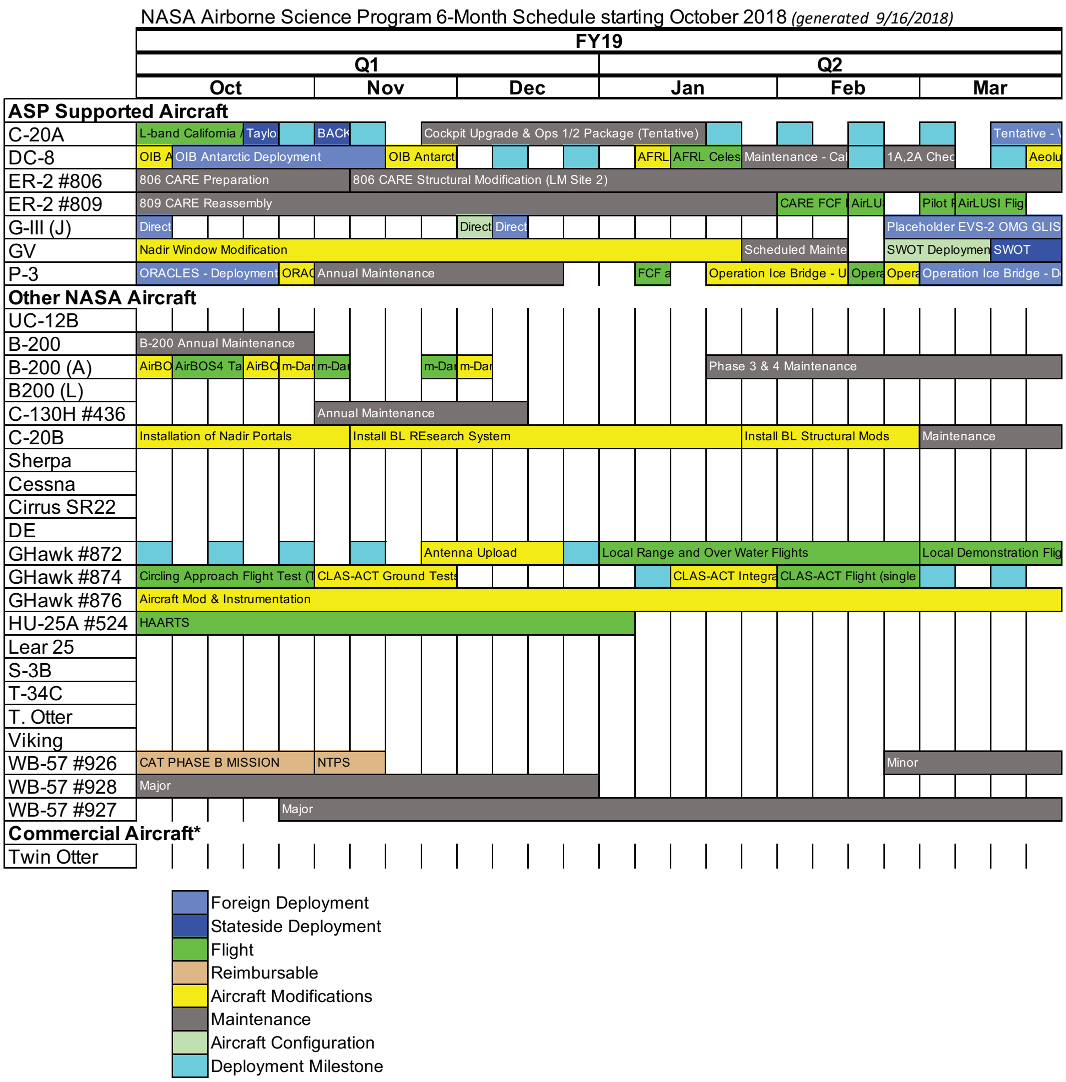
Leadership

Marilyn Vasques

Marilyn Vasques with Ryan Spackman

Marilyn Vasques, ESPO Director. In recognition of sustained and successful leadership of the Earth Science Project Office (ESPO) and support of the Airborne Science Program (ASP).

NASA SMD ESD Airborne Science Program 6-Month Schedule



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

For an up-to-date schedule, see
http://airbornescience.nasa.gov/aircraft_detailed_cal

Airborne Science Program

Platform Capabilities

Available aircraft and specs

Airborne Science Program Resources	Platform Name	Center	Duration (Hours)	Useful Payload (lbs.)	GTOW (lbs.)	Max Altitude (ft.)	Airspeed (knots)	Range (Nmi)	Internet and Document References
ASP Supported Aircraft*	DC-8	NASA-AFRC	12	30,000	340,000	41,000	450	5,400	http://airbornescience.nasa.gov/aircraft/DC-8
	ER-2 (2)	NASA-AFRC	12	2,900	40,000	>70,000	410	>5,000	http://airbornescience.nasa.gov/aircraft/ER-2
	Gulfstream III (G-III) (C-20A)	NASA-AFRC	7	2,610	69,700	45,000	460	3,400	http://airbornescience.nasa.gov/aircraft/G-III_C-20A_-_Armstrong
	Gulfstream III (G-III)	NASA-JSC	7	2,610	69,700	45,000	460	3,400	http://airbornescience.nasa.gov/aircraft/G-III_-_JSC
	Gulfstream V (G-V)	NASA-JSC	10	8,000	91,000	51,000	500	>5,000nm	https://airbornescience.nasa.gov/aircraft/Gulfstream_V
	P-3	NASA-WFF	14	14,700	135,000	32,000	400	3,800	http://airbornescience.nasa.gov/aircraft/P-3_Orion
Other NASA Aircraft	B-200 (UC-12B)	NASA-LARC	6.2	4,100	13,500	31,000	260	1,250	http://airbornescience.nasa.gov/aircraft/B-200_UC-12B_-_LARC
	B-200	NASA-AFRC	6	1,850	12,500	30,000	272	1,490	http://airbornescience.nasa.gov/aircraft/B-200_-_AFRC
	B-200	NASA-LARC	6.2	4,100	13,500	35,000	260	1,250	http://airbornescience.nasa.gov/aircraft/B-200_-_LARC
	B-200 King Air	NASA-WFF	6.0	1,800	12,500	32,000	275	1,800	https://airbornescience.nasa.gov/aircraft/B-200_King_Air_-_WFF
	C-130 (2)	NASA-WFF	12	36,500	155,000	33,000	290	3,000	https://airbornescience.nasa.gov/aircraft/C-130_Hercules
	C-23 Sherpa	NASA-WFF	6	7,000	27,100	20,000	190	1,000	http://airbornescience.nasa.gov/aircraft/C-23_Sherpa
	Cessna 206H	NASA-LARC	5.7	1,175	3,600	15,700	150	700	http://airbornescience.nasa.gov/aircraft/Cessna_206H
	Cirrus SR22	NASA-LARC	6.1	932	3,400	10,000	150	700	http://airbornescience.nasa.gov/aircraft/Cirrus_Design_SR22
	Dragon Eye	NASA-ARC	1	1	6	500+	34	3	http://airbornescience.nasa.gov/aircraft/B-200_-_LARC
	Global Hawk	NASA-AFRC	30	1900	25,600	65,000	345	11,000	http://airbornescience.nasa.gov/aircraft/Global_Hawk
	Gulfstream III (G-III)	NASA-LaRC	7	2,610	69,700	45,000	460	3,400	http://airbornescience.nasa.gov/aircraft/G-III_-_LARC
	HU-25A Falcon	NASA-LARC	5	3,000	32,000	42,000	430	1,900	http://airbornescience.nasa.gov/aircraft/HU-25A_Falcon
	Ikhana	NASA-AFRC	24	2,000	10,000	40,000	171	3,500	http://airbornescience.nasa.gov/aircraft/Ikhana
	S-3B Viking	NASA/GRC	6	12,000	52,500	40,000	350	2,300	http://airbornescience.nasa.gov/aircraft/S-3B
	SIERRA	NASA-ARC	10	100	400	12,000	60	600	http://airbornescience.nasa.gov/platforms/aircraft/sierra.html
	Twin Otter	NASA-GRC	3	3,600	11,000	25,000	140	450	http://airbornescience.nasa.gov/aircraft/Twin_Otter_-_GRC
	Viking-400 (4)	NASA-ARC	11	100	520	15,000	60	600	https://airbornescience.nasa.gov/aircraft/Viking-400
	WB-57 (3)	NASA-JSC	6.5	8,800	72,000	60,000+	410	2,500	http://airbornescience.nasa.gov/aircraft/WB-57