National Aeronautics and Space Administration

Airborne Science Newsletter

Fall 2014

What's Inside...

In Brief ...

OCO-2 Launched

The Orbital Carbon Observatory 2 (OCO-2) launched successfully from Vandenberg AFB on July 2nd. Carbon dioxide sources and sinks can now be measured from space at high resolution since OCO-2 successfully joined NASA's A-Train of Earth Observing Satellites. OCO-2 will deliver regional-scale information on carbon emissions, such as those from large metropolitan areas like Los Angeles, as well as carbon uptake by the terrestrial biosphere.

Continued on page 2

Operation IceBridge

Spring 2014 Campaign

From March 12 to May 23, Operation IceBridge carried out its 2014 Arctic field campaign. Researchers flew aboard NASA's P-3 research aircraft out of bases in Thule and Kangerlussuaq, Greenland, and Fairbanks, Alaska, to study changes to land and sea ice in the Arctic. The mission also conducted a pair of flights designed to help verify future measurements from ICESat-2, which is slated to launch in 2017.

During this 11-week-long deployment, IceBridge collected data on changing ice surface elevation and ice thickness and measured snow depth on sea ice. Several of these surveys were repeats of flights from previous years. Repeating measurements from years to year means IceBridge is able to build a long-term time series of changes to polar ice, continuing a data record started by NASA's Ice, Cloud and Land Elevation Satellite, or ICESat.

The campaign started with flights over Arctic sea ice from Thule Air Base in northern Greenland, with a week-long temporary deployment to Fairbanks, Alaska. During these flights, IceBridge measured sea ice thickness and snow depth, producing a quick look dataset before the end of the campaign that would be of use to scientists making forecasts of summer sea ice melt. Several of IceBridge's sea ice flights were in coordination with other research groups, such as the European Space Agency's CryoVEx satellite validation team.

After several weeks in Thule, IceBridge headed south to Kangerlussuaq to study coastal glaciers in the southern half of the country. These flights included measurements of Jakobshavn Glacier, which drains more than seven percent of the Greenland Ice Sheet and is one of the fastest moving glaciers in the world.

While in Kangerlussuaq, IceBridge once again hosted high school science teachers from the United States, Greenland and Denmark, giving them a first-hand look at polar airborne research. In addition, the mission was visited by a crew from the Al Jazeera America television program TechKnow, who produced a half-hour episode about IceBridge.

IceBridge finished the campaign with a return to Thule. From there, IceBridge finished the campaign's remaining high-priority sea ice surveys and collected data on glaciers in northern Greenland.

Contributed by George Hale, GSFC

In Brief *(continued from page 1)*

UAVSAR Surveys Napa Valley Earthquake Area

JPL's UAVSAR, flying on NASA Armstrong C-20A, surveyed fault displacements in the area of the August 24th Napa Valley earthquake. UAVSAR flew a five hour data collection mission on August 29th. Collecting data shortly after the earthquake will be valuable to scientists as they compare with earlier, pre-earthquake data from the same area.

Upcoming IceBridge Antarctic mission

In October and November, IceBridge researchers will head south to Punta Arenas, Chile, for another campaign of science flights over Antarctica using NASA's DC-8 airborne laboratory. Last year's Antarctic campaign was based at McMurdo Station in Antarctica. Researchers will measure rapidly changing parts of western Antarctica and the Antarctic Peninsula and sea ice in the region. Antarctic sea ice has been increasing in recent years, but this growth varies regionally. Collecting sea ice data in different regions will help scientists gain a better understanding of the processes driving changes in Antarctic sea ice cover.

Directors' Corner

Welcome to the new fall/winter version of the ASP newsletter. It has been another busy year in 2014, with over 3800 Earth Science flight hours flown in FY 14, and we have started off FY15 with our last DC-8 Operation IceBridge mission to Antarctica. I say the last, however, you never know with the scientists! We are also still flying CARVE, AirMOSS and HyspIRI flights before we slow it down for the holidays. In addition, this was a record year for multi-aircraft missions with DISCOVER-AQ (P-3, B-200, Falcon and NCAR C-130), HS3 (Global Hawk, NOAA G-IV, and the WB-57), COMEX (CIRPAS Twin Otter, ER-2, Twin Otter International, Alpha Jet), IPHEX (ER-2, UND Citation), ACCESS (DC-8, Falcon and Canada NRC's T-33) and yes, even an aircraft and ship hook-up with SABOR (UC-12B and "Endeavor"). And just for fun, we threw in a short timeframe Arctic radiation and sea ice mission called ARISE. Many thanks to everyone who makes it look easy!

I hope you all get a chance to recharge your batteries over the holidays. Please remember that the success of the program rests with you, so safe flying, safe non-flying work (we do some of that too I'm told), and yes finally, safe and Happy Holidays! 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

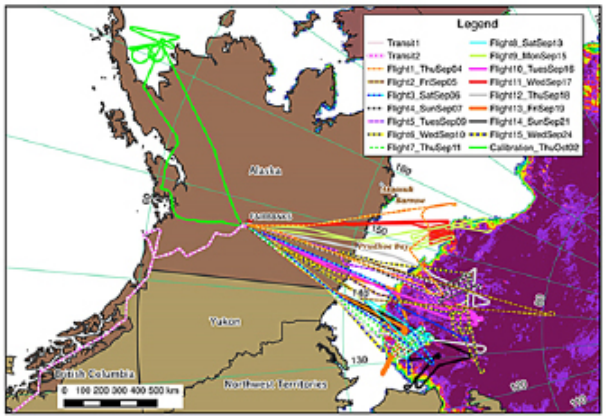
ARISE

This article is extracted from the ARISE Blog written by Project Manager Christy Hansen.

The following captures what a day in the life of the ARISE mission entailed:

7 October 2014. Eielson Air Force Base, Fairbanks, Alaska; we spent 32 days here conducting a new airborne science mission called ARISE; Arctic Radiation-IceBridge Sea and Ice Experiment. Using the Wallops Flight Facility C-130, and a team of scientists, engineers, aircraft flight crew, and logistics teams from multiple NASA centers, universities, and federal agencies, we completed 16 innovative science missions over the Arctic Basin. The map below illustrates each of our 16 flight trajectories completed.

We are currently sitting together in our mission support and flight planning room, next to the Thunderdome Hangar on base. We have appropriately named this room, where we dedicate up to 10 hours each day, our WAR room – where we passionately discuss which ARISE science objectives we'll fly each day. Our broad instrument suite (laser altimeter, radiometers, and cloud instruments) provides us with a great number of options for interesting science flights, yet ironically poses additional challenges, as each instrument requires meteorological conditions that often conflict with one another. It is here where we follow the C-130 as it flies our science trajectories, a combination of radiation cloud studies and cryospheric sciences. We can communicate



Map created by; LVIS/Matt Beckley

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ARISE *(continued from page 2)*

with the science team onboard via a basic chat system, send them occasional updated satellite imagery, track their flight, and talk on a satellite-based phone system.

New data sets will be combined and studied at the conclusion of this mission. Our general science goal is to develop an understanding of the Arctic regional energy budget. The amount of sea ice contributes to how much sunlight is reflected back to space, and thus is an important factor in the radiation balance of the Earth. In additional, we are hoping to learn more about how clouds might interact with sea ice to build a more comprehensive understanding of the Arctic energy budget as a whole. Why is this important? Because it will help us better understand our Earth system; changes to atmospheric and ocean circulations, precipitation and temperature patterns, and potential sea level rise.

We are surrounded by F-16 and F-18 jets taking off and landing all day, against a radiant and beautiful sky. We see an occasional moose on base and along the interstate during our drives in and out, all the while reminding us we are far away from home. We greet the plane as it lands each day – with a swarm of gnats in our faces.

The HS3 (Hurricane and Severe Storm Sentinel) Mission recently completed its third and final deployment at NASA's Wallops Flight Facility (WFF). A NASA Armstrong Flight Research Center (ARFC)-based Global Hawk deployed to WFF on August 26, 2014 and flew 10 science flights in the Atlantic before retuning to AFRC on September 30, 2014.

One goal of the science team was to learn more about rapid storm intensification by following severe storms through their entire life cycle, from inception to dissipation. HS3 was able to do just that, with four flights over Hurricane Edouard. That series of flights covered almost the entire life cycle of the storm, beginning with Edouard as a newly formed tropical storm during the first flight. The second flight provided an opportunity to observe rapid intensification from a weak category 1 hurricane into a strong category 2. The third flight provided great data with some well-placed dropsondes in the eye and eye wall of the storm when it was near maximum intensity. The final flight provided sampling of a rapidly weakening hurricane.

Other areas of scientific interest that HS3 addressed during this deployment were the structure of the Saharan Air Layer (SAL) and its effects on storm formation, and the extra-tropical transition of a storm as it moved to higher latitudes. HS3 also included 2 flights to the Main Development Region (MDR) in the central Atlantic, the birthplace of many hurricanes, and an inter-comparison flight with a NOAA G-IV over the Gulf of Mexico.

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WB-57 Flights Supplement HS3

The NASA WB-57 at Johnson Space Center, TX is currently flying a suite of instruments to study tropical cyclones: High Definition Sounding System (HDSS), from the Naval Research Lab, Monterey, CA (sponsored by the Office of Naval Research); High-Altitude Imaging Wind and Rain Airborne Profiler (HIWRAP), from NASA Goddard Space Flight Center, MD; and Hurricane Imaging Radiometer (HIRAD), from NASA Marshall Space Flight Center, AL. Flights are being conducted out of Ellington Field, TX and MacDill AFB, FL through the end of October.

HDSS is a new type of weather dropsonde system using a smaller, lighter sonde than traditionally used. After initial checkout flights on the WB-57 in November 2013, it has been upgraded and is ready to conduct hurricane research. HDSS is designed for high-density storm sampling to diagnose fine-scale vertical and horizontal wind and thermal structure, especially at higher altitudes near the top of the storms.

Both HIWRAP and HIRAD flew on the WB-57 in 2010, but most recently were part of the Hurricane and Severe Storm Sentinel (HS3) mission with the NASA Global Hawks from Armstrong Flight Research Center, CA. When one of the Global Hawks was delayed due to electrical issues this past September, HS3 management made the decision to move HIWRAP and HIRAD to the WB-57 and continue their hurricane research alongside HDSS. The two payloads were integrated and flying on the WB-57 within two weeks. HIWRAP provides three-dimensional wind and precipitation fields from its conically-scanning Doppler radar, while HIRAD provides surface wind speed and rain rate measurements.

Contributed by Jim Alexander

Lee Harrison installing HDSS drop tubes

Airborne Science Program 2014 Awards

Engineer
Martin Nowicki

For extraordinary performance as lead engineer and aircraft configuration manager during the busiest year in the last 44 years at the GSFC-WFF Aircraft Office supporting Airborne Science Program missions.

Project/Mission Management
Christy Hansen

For exemplary performance as project manager for the historic, first-ever NASA P3 aircraft science deployment from the ice runways at McMurdo Station, Antarctica.

Team Achievement
OIB P-3 Antarctic Mission Team

For the unprecedented excellence in conducting a historic, first-ever NASA P3 aircraft science deployment operating from the ice runways at McMurdo Station, Antarctica.

Aircraft Office: Shane Dover, Mark Russell, Mike Cropper, Gerrit Everson, Cate Easmunt, Martin Nowicki, Rich Rogers, Karalyn Springle, Dennis Rieke, Sylvia Bell, Alan Barringer, Brittany Cowger, Kelly Griffin, Brian Yates, Pete Peyton, Jeff Sigrist, Barbara LaBarge, Mike Singer, Scott Farley, Matt Elder, Jeff Chandler, Mike Anderson, Kevin Moore, Gary Zimmerman, Todd Brophy, Greg Guilfoyle, Mike Terrell, Freddie Bynum, John Doyle, Wayne Jester, Ron Teague, Steve Bildman

IceBridge Project Science Office: Michael Studinger, Christy Hansen, George Hale, Jefferson Beck

ATM Laser Team: Jim Yungel, John Sonntag, Matt Linkswiler, Serdar Manizade, John Scott, Kyle Krabill, Robbie Russell, Robert Harpold, Alexey Chibisov

DMS digital camera team: James Jacobson, Haiping Su, Eric Fraim, Dennis Gearhardt, Rose Dominguez

Gravity/Magnetics team: Stefan Elieff, Sean O'Rourke, Kevin Charles, Craig McMahon, Tejendra Dhakal, Jim Cochran, Beth Burton

CReSIS Radar Team: Matt Standish, Aaron Wells, Justin Miller, Prasad Gogineni, Carl Leuschen, John Paden, Bruno Camps-Raga, Theresa Stumpf, Bryan Townley, David Schroer, Fernando Rodriguez-Morales, Daniel Gomez-Garcia, John Hunter, Judith Riley, Jie-Bang Yan

Sustained Excellence

Mike Cropper

For exceptionally noteworthy performance over an extended time period serving the Airborne Science Program as an engineer, aircraft configuration manager, and aircraft operations manager at GSFC-WFF.

Mike Kapitzke

For sustained engineering excellence enabling the ER-2 to successfully support NASA's Airborne Earth Science Missions

Outstanding Achievement

Don Sullivan

For extraordinary engineering in designing, implementing and overseeing operations for science communications during ATTREX (Guam).

Ron Walsh

For exceptionally noteworthy performance as GSFC WFF GHOC-E construction manager and HS3 operational project manager

Other Recognition for ASP Team Members

NASA Exceptional Achievement Medal

Frank Cutler

For superior management of an on-schedule, under-budget "D-Check" and Low Utilization Maintenance Plan development and implementation resulting in a 10-year life extension for the DC-8.

Ames Honor Award

Eric Jensen

Outstanding Scientist for his work on ATTREX.

Randy Albertson

ARC/JPL/AFRC TCCON/OCO-2 cal/val collaboration

Ames Group Achievement Award

MIZOPEX Team

For outstanding achievement in executing the Marginal Ice Zone and Ocean Processes Experiment (MIZOPEX) using multiple classes of unmanned aircraft

PI James Maslanik, Univ. Colorado
NASA Ames Research Center
Univ. of Colorado, Boulder
Univ. of Alaska, Fairbanks
NOAA
SANDIA/DOE
L-3, and other partner organizations

DISCOVER-AQ Completes Field Studies

DISCOVER-AQ recently completed its fourth and final deployment in a series of field studies to improve the interpretation of satellite observations to diagnose surface air quality. Conducted over Colorado's Northern Front Range/Denver Metropolitan Area lin July and August 2014, this was the largest concentration of observations yet, as NASA's core DISCOVER-AQ team was joined by an impressive set of collaborators, in addition to longstanding partners from EPA and NOAA.

team to serve as a second in situ aircraft to map pollutant emission sources and chemistry and to sample more freely upwind and downwind of the DISCOVER-AQ study region. The overlap in payloads for the two in situ aircraft required one of the research flights to include a formation flight to compare the measurements on both aircraft. A second remote sensing aircraft, the NASA Langley HU-25C Falcon, was sponsored by NASA's GEO-CAPE science team. This plane joined the B-200 flying high

6 mobile labs, 2 tethered balloon operations, and instrumentation on a 300 meter tower at NOAA's Boulder Atmospheric Observatory. During the campaign, two flight days documented conditions for ozone that exceeded federal air quality standards. On many other days, ozone production was interrupted by afternoon storms, avoiding the potential for additional violations. Clearly identifiable chemical signatures associated with urban emissions, oil and gas exploration, and feedlot

NASA P-3B as viewed from the cockpit of the NCAR C-130 during a joint flight to compare observations. Photo by Patrick J. Reddy

Many of these collaborators were part of the Front Range Air Pollution and Photochemistry Experiment (FRAPPÉ) jointly sponsored by NCAR/NSF and the State of Colorado.

A total of four aircraft collected observations during joint flights over a network of surface sites across the region. NASA's P-3B from NASA Wallops Flight Facility and B-200 King Air from NASA Langley Research Center were the main platforms supporting DISCOVER-AQ with the P-3B providing in situ profiles over air quality ground monitoring sites and the B-200 providing remote sensing of gaseous and particulate pollution from high overhead. The NCAR C-130 was fielded by the FRAPPÉ

overhead with GeoTASO onboard, a UV-spectrometer instrument developed at Ball Aerospace to demonstrate the technology that will be used in future geostationary satellite observations of air quality.

Beneath these four aircraft, the ground network was also populated with an unprecedented array of observations to augment the local air quality network maintained by the Colorado Department of Public Health and Environment. This included 10 lidars (measuring ozone, aerosols, and winds), 16 Pandora spectrometers for remote sensing of trace gases, 20 AERONET sunphotometers for aerosol remote sensing, 4 in situ trailers,

operations across the area will provide critical information on the contribution of these sources to local air quality conditions. More information on all of the DISCOVER-AQ deployments can be found on the project website at: http://discover-aq.larc.nasa.gov/

Contributed by Jim Crawford

GeoTASO and DISCOVER-AQ in Colorado

The ESTO-funded GeoTASO airborne sensor is an airborne spectrometer flying on the NASA HU-25C Falcon that advances retrieval algorithm development and mission readiness for the TEMPO and GEMS air quality measurement missions. GeoTASO stands for Geostationary Trace gas and Aerosol Sensor Optimization. Its main objective is to assess and improve the performance of the full sensor-algorithm system. The UV-Visible multi-order spectrometer gives high spectral and spatial resolution measurements that feed both trace gas and aerosol retrieval algorithms to test algorithm performance with real-world scene data. Flying on the Falcon at 32 kft provides a space-like vantage point of the atmosphere's boundary layer where the air quality measurements are needed. The image below (left) shows the sensor on the Falcon and the scene observed.

The spectrometer has swappable slits that vary the passband and spectral sampling as a test of sensor-algorithm performance as a function of these values. Its polarization sensitivity is kept small with a photo-elastic modulator based depolarizer – another ESTO-funded project that scrambles the polarization of incoming light while maintaining high image quality.

Contributed by Jim Leitch
Ball Aerospace

(Left) The sensor is shown mounted in the nadir well on the Falcon with its operating station and support electronics behind it. The sensor looks down through a fused silica window with a 45 degree crosstrack field of view. (Right)A view of the zenith sky can be selected during the flight using a fiber optic connection to a zenith port.

The Carbon Dioxide (CO2) and MEthane experiment (COMEX), used multiple aircraft to measure the two greenhouse gases using gas analyzers and spectrometers. Principal Investigator (PI) Ira Leifer worked with NASA and the European Space Agency (ESA) to equip a Twin Otter provided by the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS) at the Naval Postgraduate School in Monterey, California, with instruments, including the University of Bremen Methane Airborne Mapper (MAMAP) sensor. MAMAP is a non-imaging spectrometer that makes plume transits at high spectral resolution and with high sensitivity to carbon dioxide and methane. The CIRPAS Twin Otter also flew two instruments from NASA Ames Research Center: a Picarro gas analyzer modified for flight and a CO2 isotope instrument made by Los Gatos Research. MAMAP and the gas analyzers then flew under the Airborne Visual InfraRed Imaging Spectrometer Next Generation (AVIRIS-NG) developed by NASA's Jet Propulsion Laboratory in Pasadena, California, which images, or "maps" methane at a higher spatial resolution but lower spectral resolution and sensitivity than MAMAP.

"Our understanding of methane emissions from many important sources remains poor," said Ira Leifer, COMEX PI. "For example, a recent review of many field studies over the last decade concluded that industrial fossil fuel emissions – the primary methane source – had been underestimated by a factor of approximately two."

The CIRPAS Team

COMEX collected data from key methane sources in the San Joaquin Valley and the Greater LA Area, including oil production and refining, animal husbandry, natural geology, and landfills with supporting in situ airborne (i.e., flights within the actual plumes of gas) and surface data for validation of higher-altitude airborne information. COMEX data informs potential future satellite missions in both the U.S. and Europe. NASA is studying a mission known as the Hyperspectral Infrared Imager or HyspIRI, while ESA considers the CarbonSat mission a candidate for its Earth Explorer 8, to be launched in 2022. COMEX provided test data sets, design guidance and improved emission algorithms for these activities.

Contributed by Ira Leifer, UC Santa Barbara and Bernie Luna, ARC

HS3 *(continued from page 3)*

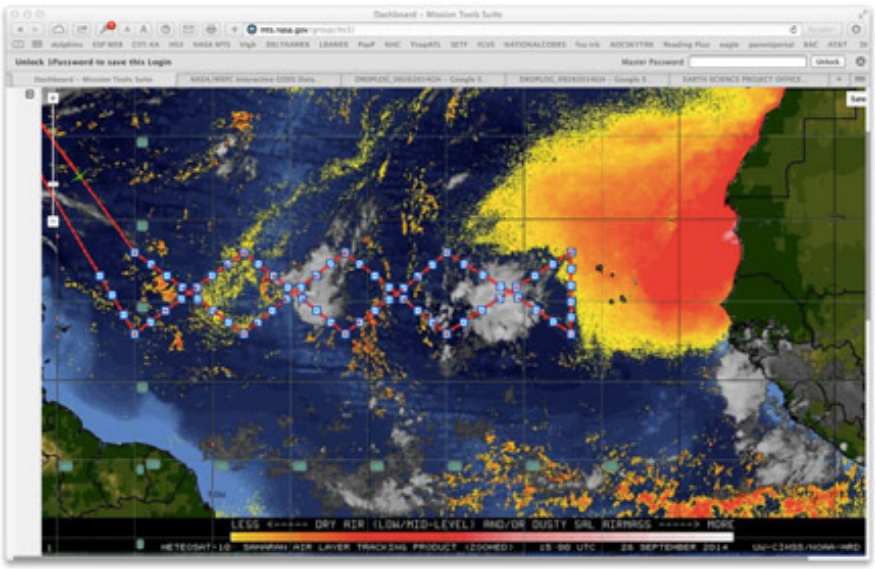
Additional highlights for this year included flights to three different named storms, Cristobal and Dolly, in addition to Edouard. A total of 10 science flights and 236 science hours were flown. That brings the three-year total for HS3 to 8 different named storms, 30 science flights and 642 hours flown.

All of the instruments on HS3's environmental Global Hawk (NASA 872, also known as AV-6), including the Scanning High-Resolution Interferometer Sounder (S-HIS), Cloud Physics Lidar (CPL) and Advanced Vertical Atmospheric Profiling System (AVAPS), performed well and collected data throughout the deployment. AVAPS dropped a total 649 sondes this year for a 3-year total of 1425.

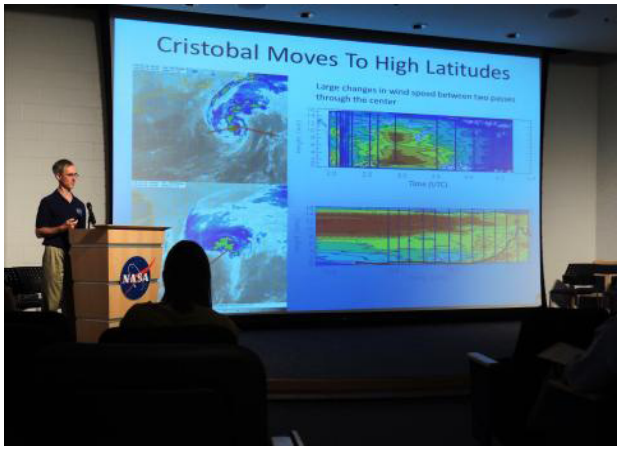
A media/education day was held on September 11 with presentations of the project and tours of the aircraft and operations center.

Principal Investigator Scott Braun of NASA GSFC and Project Manager Marilyn Vasques of NASA ARC led the HS3 mission with collaborative efforts by nearly all the NASA centers, the National Oceanic and Atmospheric Administration, the National Center for Atmospheric Research, the Naval Research Laboratory, the Naval Postgraduate School, the University of Wisconsin, State University of New York at Albany, University of Utah, University of Maryland–Baltimore County, Penn State University and other organizations. Over 300 people made up the HS3 team and contributed to the success of the project.

Contributed by Quincy Allison



The flight plan for HS3 Science Flight #10, flown September 28-29, into the Main Development Region where most Atlantic hurricanes form. Screenshot: NASA.



PI Scott Braun during Media Day, Sept. 11, 2014.

Local Teachers at WFF for Media Day

Students from Fruitland Intermediate School learn about HS3 and MTSE.

IPHEx does cal/val for GPM

The NASA Global Precipitation Measurement (GPM) Mission Integrated Precipitation and Hydrology Experiment (IPHEx) took place in the Appalachian Mountains of southwestern North Carolina from May 1 – June 15, 2014. GPM IPHEx partners included Duke University and the NOAA Hydrometeorological Testbed. Overarching campaign objectives included the improvement of satellite-based remote sensing algorithms of clouds and precipitation over mountainous terrain, and evaluation and further development of associated data products for use in hydrologic applications such as flood prediction.

To achieve these objectives an extensive set of airborne and ground-based instruments were deployed and operated under occasional overpasses of GPM constellation satellite platforms. Participating aircraft included the NASA ER-2 and University of North Dakota Citation. At high altitude, the ER-2 served as a "proxy" satellite platform carrying the AMPR and CoSMIR radiometers spanning frequencies from 10-183 GHz, and the CRS, HIWRAP, and EXRAD radars covering the W, Ka, Ku, and X bands. Indeed, IPHEx was the first NASA field effort to ever deploy and operate four cloud and precipitation radar frequencies from the same high-altitude airplane. The University of North Dakota Citation aircraft carried a suite of in situ cloud microphysics probes to sample cloud and precipitation processes within the field of view of ER-2 and ground-based instruments. At the ground, an extensive array of NASA and NOAA multi-parameter radars (NASA/WFF NPOL and D3R radars, NOAA NOXP radar), disdrometers, rain and stream gauge networks were deployed and operated on a 24/7 basis to complete observations of precipitation formation and movement through the coupled atmosphere-hydrologic system. IPHEx scientists successfully collected 113 hours of ER-2 and 78 hours of Citation airborne data and six full weeks of ground-based science data over a wide variety of storm types ranging from heavy raining mountain cloud systems that produced strong hydrologic response, severe hail storms, to smaller and more lightly raining maritime clouds. Collectively the IPHEx observations will provide a comprehensive view of orographic precipitation processes, what those processes actually "look like" as viewed from GPM spaceborne instrumentation, and subsequently how to better estimate precipitation rates over complex terrain.

Contributed by Walt Peterson

Top: NASA NPOL and D3R radars move to sample a strong storm. Bottom left: ER-2 view of a severe storm sampled during a GPM overpass. Right: UND Citation penetrating complex stratiform cloud and precipitation layers.

SABOR

A major collaboration of air and sea measurements took place this summer (July-August) in the Ship-Aircraft Bio-Optical Research (SABOR) mission. With funding provided by NASA's Ocean Biology and Biogeochemistry Program, the SABOR experiment brought together marine and atmospheric scientists to tackle the optical issues associated with satellite observations of phytoplankton. Flying on the NASA Langley UC-12B, the payload consisted of NASA Langley's High Spectral Resolution Lidar Version 1.1 (HSRL 1.1) and the Research Scanning Polarimeter (RSP) from the NASA Goddard Institute for Space Studies (GISS), with the goal of monitoring microscopic plants that form the base of the marine food chain.

The National Science Foundation's Research Vessel "Endeavor", operated by the University of Rhode Island, was the floating laboratory that scientists used for the ocean-going portion of the SABOR field campaign. Scientists on the "Endeavor" studied ocean ecosystems from the Gulf of Maine to the Bahamas.

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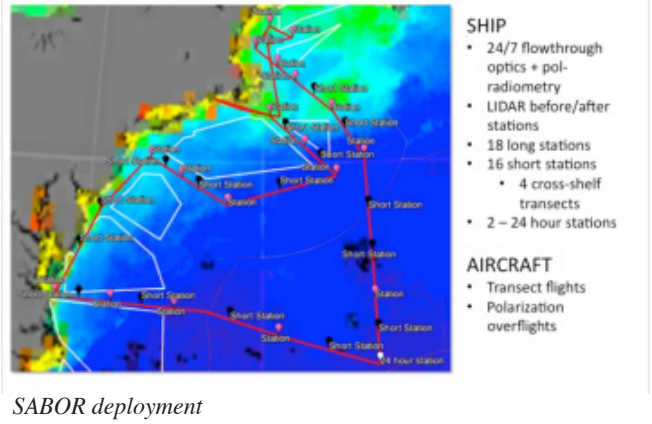


SABOR deployment

ASCENDS Summer 2014

The GSFC CO2/O2 Sounder (ASCENDS) team completed their flight campaign on September 8th with a long flight (11.5 hrs) to the mid-west (Iowa and Indiana). The ASCENDS campaign lasted for approximately 6 weeks starting in late July and included the following candidate ASCENDS Lidar Instruments from 3 different NASA centers: GSFC CO2-O2 Lidar Sounders; LaRC/Exelis IM-CW CO2 Lidar (MFLL); JPL CO2 LAS; Two in-situ greenhouse gas instruments (one from LaRC and one from GSFC) also participated.

One Engineering flight and 5 science flights were carried out for approximately 40-45 hours of flight time. All flights used NASA's DC-8 airborne laboratory based at AFRC in Palmdale, CA.

Submitted by Haris Riris and Jim Abshire

ASCENDS tracks for Summer 2014.

Bill Hasselbrack (GSFC) and Stewart Wu (GSFC) left monitor the CO2 sounder system during flight. The left console monitors the "Step-Tuned Frequency Locked" laser system and the right console monitors the CO2 sounder. Clearly seen in the right monitor are the pulses and CO2 absorption. The color plot monitors the atmospheric backscatter. These displays give the operators real time information on the instrument and atmosphere.

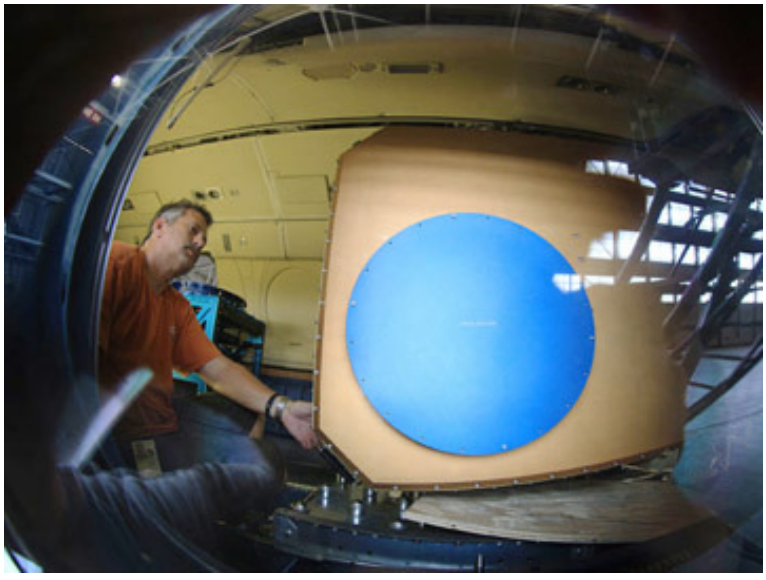
ASCENDS CarbonHawk Experiment Simulator (ACES)

To address these data gaps and aid in the refinement and understanding of the global carbon cycle budget, laser-based instruments that do not rely on sunlight are being developed in support of the future NASA Active Sensing of CO2 Emissions over Nights, Days, and Seasons (ASCENDS) satellite mission.

Another instrument is the ASCENDS CarbonHawk Experiment Simulator (ACES), is an Intensity-Modulated Continuous-Wave lidar system recently developed at NASA Langley Research Center (LaRC) that seeks to advance technologies and techniques critical to measuring atmospheric column CO2 mixing ratios.

Full instrument development concluded in the spring of 2014 after 3.5 years of effort funded by LaRC and NASA's Earth Science Technology Office (ESTO) Instrument Incubator Program (IIP). Following ground tests of the instrument, ACES successfully completed its first test flights in July 2014, flying six times (17.4 hours) with the NASA Langley HU-25C Falcon as the sampling platform. The research flights were conducted from the LaRC Flight Research Hangar and recorded data at multiple altitudes over land and ocean surfaces with and without intervening clouds, which are all important situations to understand for future space-based measurements. Measurements of CO2 were simultaneously gathered in situ on the aircraft to validate the ACES measurements. ACES is eventually expected to serve as a satellite instrument simulator on board the NASA Global Hawk aircraft. The team, which includes partners from Exelis, Inc., Atmospheric and Environmental Research (AER), and Oklahoma University, is currently analyzing the flight data sets.

Contributed by Mike Obland



ACES instrument box being installed as viewed from the exterior right side of the NASA Langley Research Center Hu-25C (courtesy NASA/ David C. Bowman)

SABOR *(continued from page 9)*

The airborne portion of the campaign consisted of a total of 30 flights, constituting 92.5 flight hours. The research flights were conducted from Pease Air Force Base (Portsmouth, NH), Bermuda, and NASA Langley. Flight operations from the Research Services Directorate at LaRC were able to support the mission with multiple flights per day and multiple days in a row.

Principal Investigator Chris Hostetler made the following comments: "From the science perspective, the SABOR was a huge success. We acquired lidar and polarimeter ocean data coincident with in-water measurements made from the ship in a large number of locations with water conditions ranging from turbid coastal waters to the very clear blue waters of the deep ocean. To our knowledge, this is the most extensive mission of its type ever conducted. The data acquired will help us promote and justify a future ocean-atmosphere satellite lidar mission and provide critical information on the design of the lidar instrument for that mission and for an ocean upgrade to HSRL-2."

Contributed by Chris Hostetler and Bruce Fisher

Technician Richard Hare installs instruments on NASA's UC-12 aircraft at NASA's Langley Research Center in preparation for the airborne portion of the SABOR field campaign (courtesy NASA/David C. Bowman)

SARP

NASA Student Airborne Research Program 2014

Thirty-two undergraduate students from a like number of colleges and universities participated in an eight-week NASA Airborne Science Program field experience designed to immerse them in the agency's Earth Science research.

Flying aboard NASA's DC-8 airborne laboratory, students measured pollution, aerosols, and air quality in the Los Angeles basin and California's central valley. They also used remote sensing instruments to study forest ecology in the Sierra Nevada and ocean biology along the California coast.

NASA's Student Airborne Research Program (SARP) provides a unique opportunity for undergraduate students majoring in the sciences, mathematics and engineering to participate in all aspects of a NASA Airborne Science research campaign. 2014 was the 6th summer the program has been offered.

SARP began June 16, 2014 at NASA Armstrong Flight Research Center's facility in Palmdale, California, with lectures by university faculty members, NASA scientists and NASA program managers. The students flew aboard the DC-8 on five flights during the week of June 23. They acquired multi-spectral images of kelp beds in the Santa Barbara Channel and of forests in the Sierra Nevada.

In addition, the students flew over dairies and oil fields in the San Joaquin Valley, parts of the Los Angeles basin and the Salton Sea at altitudes as low as 1,000 feet in order to collect air samples, measure aerosols and air quality. During the final flight, half of the students were in the field taking ground validation or complementary measurements while the DC-8 flew overhead.

The final six weeks of the program took place at the University of California, Irvine where students analyzed and interpreted the data they collected from science instruments on the aircraft. At the conclusion of the program, the students each delivered final presentations about their results and conclusions in front of an audience of NASA scientists and administrators, university faculty members and their fellow SARP students. Eight students will present their SARP research projects at the 2014 Fall AGU Meeting in San Francisco.

SARP 2014 participants pose in front of the NASA DC-8 on June 20, 2014. Photo credit: NASA

SARP is managed by NASA's Ames Research Center at Moffett Field, California, through the National Suborbital Education and Research Center (NSERC) at the University of North Dakota. As part of the Ames Cooperative for Research in Earth Science and Technology, NSERC receives funding and support from NASA's Earth Science Division. http://www.nserc.und.edu/sarp

Contributed by Emily Schaller

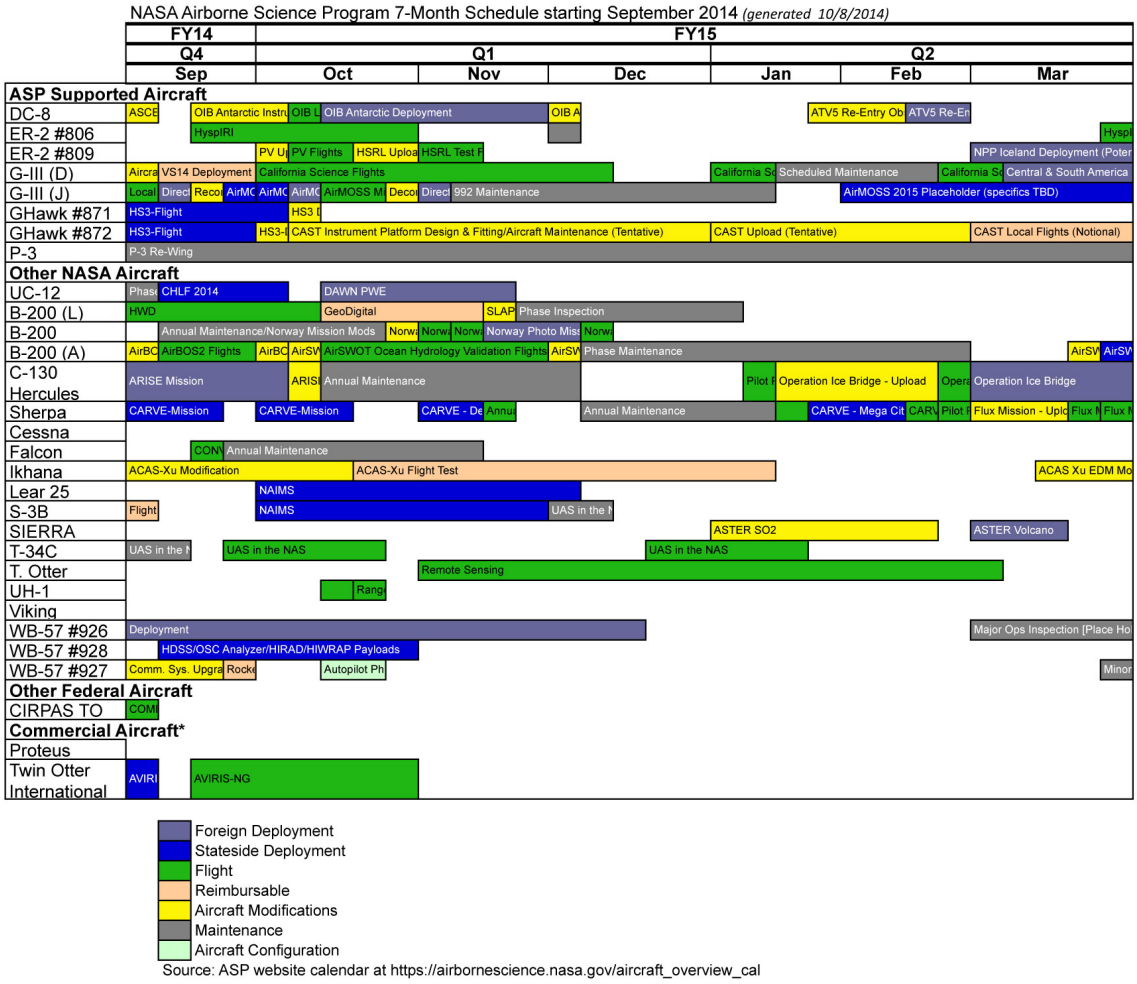
Brian Hobbs new ER-2 Program Manager

The Airborne Science Program welcomes Brian Hobbs as the new ER-2 platform program manager at AFRC. Brian has over 28 years of experience in engineering and program management on a wide variety of Air Force programs. Brian will succeed Tim Moes, who will be taking over management of the DC-8 platform in November after the aircraft returns from Operation Ice Bridge. Tim will succeed Frank Cutler, who will assume duties as the Global Hawk program manager in early 2015. Chris Naftel, the current GH PM, is planning to retire in early 2015.

Chris Miller moves to AFRC Exploration Mission Directorate

Chris Miller of AFRC has accepted a position in the AFRC Exploration Mission Directorate to manage a proposed Microgravity Flight Services Project. Chris has been a long time mission manager for DC-8 and ER-2 projects both at ARC and AFRC. The ASP wishes Chris the best of luck and success in his new position.

NASA SMD ESD Airborne Science Program 6-Month Schedule



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

ASP Upcoming Events

* 2014 Aquarius / SAC-D Science Team Meeting
  Nov. 11-14, 2014; Seattle, WA
  http://depts.washington.edu/uwconf/wordpress/aquarius/

* 17th Symposium on Meteorological UAS TAAC 2014
  Dec. 9-11, 2014; Santa Ana Pueblo, NM
  https://taac.psl.nmsu.edu/
  REGISTRATION IS OPEN

* 2014 Fall AGU
  Dec. 15-19, 2014; San Francisco, CA
  http://fallmeeting.agu.org/2014/
  RESISTRATION IS OPEN

* 95th AMS Annual Meeting
  Jan. 4-8, 2015; Phoenix, AZ
  http://annual.ametsoc.org/2015/

* AAIA Infotech@Aerospace Conference
  http://www.aiaa-scitech.org/Infotech/
  REGISTRATION IS OPEN
  53rd AIAA Aerospace Science Meeting
  5-9 January 2015; Kissimmee, FL
  http://www.aiaa.org/EventDetail.aspx?id=20992

* SPIE 2014 Remote Sensing
  Amsterdam; 22 – 25 September 2014
  http://spie.org/x6262.xml?WT.mc_id=RERS14CE

* 3rd International A-Train Symposium 2015
  March 4-6, 2015; Pasadena, CA
  http://cce.nasa.gov/cce/pdfs/A-Train-2015_1st_circular_Rev3.pdf

* IEEE AEROSPACE Conference
  March 7-14, 2015; Big Sky, MT
  http://www.aeroconf.org/
  RESISTRATION IS OPEN

* NASA Carbon Cycle and Ecosystems Joint Science Workshop
  April 20-24, 2015; College Park, MD
  http://cce.nasa.gov/meeting_2015/index.html

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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-DFRC	12	30,000	340,000	41,000	450	5,400	http://airbornescience.nasa.gov/aircraft/DC-8
	ER-2	NASA-DFRC	12	2,900	40,000	>70,000	410	>5,000	http://airbornescience.nasa.gov/aircraft/ER-2
	Gulfstream III (G-III) (C-20A)	NASA-DFRC	7	2,610	69,700	45,000	460	3,400	http://airbornescience.nasa.gov/aircraft/G-III_C-20A_-_Dryden
	Gulfstream III (G-III)	NASA-JSC	7	2,610	69,700	45,000	460	3,400	http://airbornescience.nasa.gov/aircraft/G-III_-_JSC
	Global Hawk	NASA-DFRC	30	1900	25,600	65,000	345	11,000	http://airbornescience.nasa.gov/aircraft/Global_Hawk
	P-3B	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-DFRC	6	1,850	12,500	30,000	272	1,490	http://airbornescience.nasa.gov/aircraft/B-200_-_DFRC
	B-200	NASA-ARC/ DOE	6.75	2,000	14,000	32,000	250	1,883	http://airbornescience.nasa.gov/aircraft/B-200_-_DOE
	B-200	NASA-LARC	6.2	4,100	13,500	35,000	260	1,250	http://airbornescience.nasa.gov/aircraft/B-200_-_LARC
	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
	Dragon Eye	NASA-ARC	1	1	6	500+	34	3	http://airbornescience.nasa.gov/aircraft/B-200_-_LARC
	HU-25C Falcon	NASA-LARC	5	3,000	32,000	42,000	430	1,900	http://airbornescience.nasa.gov/aircraft/HU-25C_Falcon
	Ikhana	NASA-DFRC	24	2,000	10,000	40,000	171	3,500	http://airbornescience.nasa.gov/aircraft/Ikhana
	Learjet 25	NASA-GRC	3	3,200	1,500	45,000	350	1,200	http://airbornescience.nasa.gov/aircraft/Learjet_25
	S-3B Viking	NASA/GRC	6	12,000	52,500	40,000	450	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
	T-34C	NASA-GRC	3	500	4,400	25,000	75	700	http://airbornescience.nasa.gov/aircraft/T-34C
	Twin Otter	NASA-GRC	3	3,600	11,000	25,000	140	450	http://airbornescience.nasa.gov/aircraft/Twin_Otter_-_GRC
	WB-57	NASA-JSC	6	6,000	63,000	60,000+	410	2,500	http://airbornescience.nasa.gov/aircraft/WB-57

ASP Upcoming Events

Continued from page 7

* AGU Joint Assembly
  3-7 May, 2015; Montreal, Canada
  http://ja.agu.org/2015/

* AUVSI Unmanned Systems North America 2015
  May 4-7, 2015; Atlanta, GA
  http://www.auvsishow.org/auvsi2015/public/enter.aspx

* 36th International Symposium on Remote Sensing of Environment (ISRSE)
  11-15 May 2015; Berlin, Germany
  http://www.isrse36.org/
  Call for Papers closes October 25, 2014

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.

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