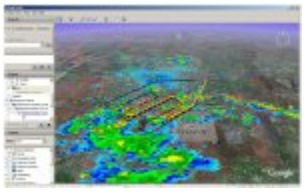
Flynn's Field Files

Bob Hannigan, Pilot

Dick Hone, Pilot

John Ogren, NOAA

Yours truly! PNNL



In the Google Earth image, the black line represents the initial flight plan. The yellow line with red shading shows the G-1 location transmitted to us every 90 seconds. The brightly colored patches indicate rainfall detected by national weather service radar, which provides automatic updates more than once per minute. These weather systems were vigorous, rapidly developing storms. For example, the southern most flight leg was foreshortened to avoid a very active storm cell that had been directly ahead. By the time this image was captured about 30 minutes later, the storm has already moved a considerable distance. Enlarge image

Week 1

June 9-15, 2007

Daily Log - June 15, 2007
Another great day! The G-1 flew today and had an outstandingly successful flight.

Due to unfavorable weather conditions this week, it has been a few days since we'd had a science flight. This morning, despite local weather at the hangar threatening rain, our weather forecasters were predicting favorable weather in the surrounding region. There was no mistaking the eagerness and excitement of all the researchers! Wherever I went, people kept asking, "Are we really going? Is it still on? Have you heard any word?"

The flight plan called for mostly level legs at 4000 feet in the hopes of getting plenty of passes through small, fair weather cumulous and that is exactly what we got. Legs are the prescribed flight patterns the pilot follows.

Our weather forecasters Daniel Hartsock and John Harris really hit the nail on the head with this one. Nice call guys!

Special credit also goes to our excellent pilots Bob Hannigan and Dick Hone. Although we found the small, low altitude clouds we were after, they were in the midst of towers of severe storms. Our pilots did a masterful job of diverting around the storms and then recovering the desired flight plan.

The capability to coordinate all of these different elements through Google Earth has been developing right here in the field over the last few days through the efforts of John Ogren (NOAA) and myself. It would not have been possible without the superb website http://radar.weather.gov/ridge/kmzgenerator.php. If you have Google Earth (free download) and would like to see a display of weather in your area or even centered on your home, visit the above site and have fun.

Yin-Nan Lee, BNL

Liz Alexander, PNNL

Matt Newburn, PNNL

Damaged Turbo Pump.
Enlarge image

Daily Log - June 14, 2007

Field campaigns come with plenty of opportunities for problem-solving. Today, we discovered that the AMS (Aerosol Mass Spectrometer) operated by Yin-Nan Lee of Brookhaven National Laboratory had experienced a catastrophic failure of one of its turbo pumps. Fortunately, some excellent inter-laboratory collaboration led to a very rapid recovery. We are back on track for a G-1 flight tomorrow and crossing our fingers for good weather.

The AMS helps identify the size and chemical composition of atmospheric aerosol particles. It operates in a high vacuum of about one-billionth atmospheric pressure. To achieve this high vacuum, the AMS uses a turbo pump, which is very similar to a jet turbine. Instead of using valves and compression, the turbo pump uses high-speed turbine blades spinning thousands of times per second.

Sometimes, through normal wear and tear, the bearings in a turbo pump wear out. When this happens, the results are spectacular (as you can see in the photo). Without this critical component, the AMS simply can't function.

However, in the spirit of true collaboration and teamwork, Liz Alexander and Matt Newburn, Pacific Northwest National Laboratory staff, express shipped a replacement turbo pump from their lab in DOE's national scientific user facility at PNNL, the Environmental Molecular Sciences Laboratory. They helped Yin-Nan replace the broken turbo pump in time for the tomorrow's flight. Way to go team!

Larry Kleinman, BNL

This is a whole sky image from one of the remote data sites. It is raining there too!

Three inches of rain fell overnight. - Enlarge image

Daily Log - June 13, 2007

Another rainy day in Ponca City, Oklahoma. Boy, did we have a gully washer last night! More than 3 inches of rain fell in some areas over night.

This much rain is about one-fourth of what we get over the entire year back home in Richland, Washington. The forecast is for more of the same for at least the next couple of days.

Flights plans have been scrubbed and many of us are focusing on analyzing data or servicing and tweaking instrumentation.

As for me, I'm trying to learn a new data analysis package. Over the past few years, I have written many thousands of lines of computer code using Matlab, a different analysis package; however, many of my compatriots use a software tool called "Igor." Whenever I read that name and look at my code, I can't help but think of the phrase, "I've created a MONSTER." So far, though, my initial "creations" (small coding scripts) have worked fine.

It's a bit hard to describe, but trying to learn an entirely new software package is exciting and intimidating at the same time. I imagine it is something like a skilled woodworker learning to do metal work. Some of the skills transfer readily, but there are still so many new techniques to learn. Luckily, I have the good fortune of having experts like Stephen Springston and Larry Kleinman sitting in the same room with me.

With the lull in local activities, my thoughts turn further afield. For example, researchers at PNNL and Argonne National Laboratory have collaborated to establish a surface measurement site north of Oklahoma City. We can see an image of the sky at this remote site updated every five minutes from this website: ftp://ftp.arm.gov/pub/sites/parsl/recent.html.

Stephen Springston, BNL

Gunnar Senum, BNL

The Cloud, Aerosol, and Precipitation Spectrometer removed from the aircraft for servicing and maintenance. - Enlarge image

Daily Log - June 12, 2007

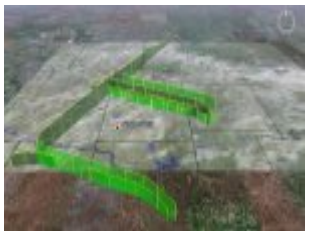
The G-1 did not fly today, so I spent part of the day examining results from yesterday's successful flight. One of the first steps involves comparing independent measurements of the same quantities (or related quantities) measured by different instruments and researchers. Two days ago, I described the Gerber probe, which measures the total water content and total surface area of the cloud droplets sampled. From the combination of these two properties, we can also infer the average size of the sampled cloud droplets.

To check the measurements from the Gerber probe I've been working with Stephen Springston and Gunnar Senum of Brookhaven National Lab.

Stephen and Gunnar are experts with a number of the instruments aboard the G-1. They have deployed a Cloud, Aerosol, and Precipitation Spectrometer (CAPS) by Droplet Measurement Technologies aboard the G-1 in support of field experiments for the past three years. The CAPS probe is actually several independent probes rolled into one system. It measures temperature, relative humidity, airspeed and altitude, liquid water content, and particle size. It even scans images of particles as they zip past. Comparing the measurements of liquid water content and particle size from the Gerber probe and the CAPS will allow us to improve our overall determination of these cloud properties.

These comparisons are very important from a technical perspective, but they are also exciting from a personal perspective. Stephen has been involved with the G-1 for more than 10 years and Gunnar has been involved for several years as well. In contrast, this is my very first mission not only with the G-1 but with aircraft measurements as a whole. The close collaboration intrinsic to field experiments naturally brings new researchers (me, in this case!) in direct contact with respected leaders in the field. This adds an interesting dynamic and is personally and professionally very exciting.

Preparing the Gulfstream-1 aircraft for departure. The yellow cart to the left of the landing gear provides power to start both main engines. The heavy black cables beneath the aircraft provide power to the scientific instrumentation until after the engines are running. - Enlarge image



Composite of Google Earth image of terrain, satellite map of clouds, and G-1 transmitted flight path. This image was generated on the fly while the G-1 was aloft, using software developed by Craig Strait, at Pacific Northwest National Laboratory. - Enlarge image

Daily Log - June 11, 2007

Today was a great day! After the cancelled mission plans yesterday, we were all excited to have another go at it. Arriving at the hangar before 7:00 AM, we began preparing the G-1 for an 11:00 AM departure time. In the photo, the G-1 is almost ready to go. Note the orderly arranged cables beneath the wings and body of the aircraft. While aloft, generators aboard the aircraft supply all the electrical power that our instrumentation needs, but while the engines are shut down on the ground, we supply external power using the heavy cables shown in the photo. These cables are my life line! Before the G-1 can depart I need to disconnect these cables from the aircraft - but not until the turbines are running full swing. By walking closely along the cable lines I keep safely away from the spinning propellers and the scorching jet exhaust. But talk about LOUD!! Thank goodness for earplugs and headphones! I wear both at the same time.

Today the G-1 flew a coordinated pattern with the NASA King Air, upwind and downwind of Oklahoma City. By measuring the particulate matter, aerosols, and trace gases, we hope to identify the plume of air leaving this urban area and to understand the effect it has on the formation, properties, and behavior of clouds. For example, clouds require small aerosol particles in order to form (nucleate) cloud droplets from water vapor. But it is also known that the presence of aerosols may at times suppress cloud formation. A key goal of this field experiment is to improve our understanding of these complex interdependencies between clouds and aerosols.

Science meets nature in Oklahoma - Enlarge image

The gold-colored instrument is the Gerber probe. A laser is located inside the end attached to the airplane. Light sensors are located in the end farthest from the airplane. As the plane flies through clouds, some of the cloud droplets pass through the cylindrical opening and scatter light from the laser beam into the light sensors. With this probe, we can determine the liquid water content, the total surface area, and the cloud droplet size. - Enlarge image

Daily Log - June 10, 2007

As I was sitting at my computer this morning, I noticed some Oklahoma wildlife right outside the window. The window glass is tinted dark to block sunlight so apparently the wildlife didn't even notice me. The bunny rabbit would perch on its hind legs to nibble at the tender leaves while at least a dozen little birds flitted about on the ground and in the bushes. A pretty nice way to start the morning!

Today we anticipated flying a coordinated mission with multiple aircraft. However, the early morning weather briefing suggested a low likelihood of finding the small puffy cumulus clouds that most interest the scientists so our flight plans were cancelled, saving the flight hours for more optimal conditions.

Whenever the aircraft is on the ground we take the opportunity to service it and to check and/or calibrate our instrumentation. This time was no exception. Here is a picture of a "Gerber probe." The Gerber probe uses a laser to measure properties of clouds and cloud droplets as the aircraft flies through them. I removed it, disassembled and cleaned it, reassembled it, and then re-installed. This was my first time to service this instrument so you can imagine my relief when it worked like a charm after I turned it back on. Woohoo!

The G-1 is readied for CHAPS at its home base in Pasco, WA - Enlarge image

Pictured from left to right: Yin-Nan Lee, John Jayne, Betsy Andrews, Connor Flynn, Matt Newburn, Claudio Mazzoleni, Ian McCubbin, Yury Desyaterik, Liz Alexander, John Hubbe, Gunnar Senum, Jason Olfert, Carl Berkowitz, Stephen Springston, Peter Daum, John Ogren, Larry Berg. Photo taken by Lynne Roeder.- Enlarge image

Daily Log - June 9, 2007

Hello all! Welcome to the first posting of Flynn's Field Files. Last week we arrived safely in Oklahoma with the Gulfstream-1 aircraft, after a brief diversion to Phoenix to avoid strong storms. Since then, we have kept very busy working 12+ hour days preparing the aircraft and instrumentation for the mission, and performing initial flights. As of today, all of the instruments have been integrated aboard and have been tested in pre-campaign test flights, and we have flown one Oklahoma City flight. The instruments aboard the G-1 represent the state-of-the-art in atmospheric aerosol measurements and are fielded by leading researchers from across the country, with whom I will have the distinct pleasure of working!

Over the next three weeks, in addition to providing on-the-fly updates of events during this intensive field campaign, we'll highlight several of the research teams and the measurements they'll be conducting from the G-1. Here is a photo of most of the G-1 team with the tail of the G-1 extending out of the hangar doors.