Research Drones: A Scientist’s Guide for Spying on the Atmosphere by Cameron Homeyer

Unmanned aerial vehicles (UAVs, or “drones”) have been used for several decades to perform tasks that are not desirable for manned aircraft flights (e.g., dangerous military reconnaissance, flights exceeding 10 hours). More recently, UAVs have become popular for commercial uses such as crop surveying, filmmaking, and domestic policing (yes, the road signs stating “speed monitored by aircraft” are real). However, aside from military UAVs, most systems used for alternative purposes today are small in size, limited in flight range and altitude, and often designed for a single purpose. Despite many of the physical limitations with UAVs, they have become a popular tool for atmospheric research in recent years.

An important scientific advancement involving UAVs comes with the addition of two Northrop Grumman autonomously operated Global Hawk (GH) aircraft to the NASA airborne fleet for long-duration Earth science missions (see Figure 1). The GH aircraft were acquired by NASA in 2007 from the United States Air Force, and were part of an original group of concept UAVs funded through the Department of Defense’s (DoD) Defense Advanced Research Projects Agency (DARPA). With the efforts of many civilian scientists, engineers and members of the U.S. Air Force, these GH aircraft were transitioned into systems capable of novel science applications for observing the troposphere and the lower stratosphere across the globe. The GH is capable of flight times up to 30 hours, ranges out to 16000 km, and altitudes up to 20 km.

Because of their long range and high-altitude capabilities, the GH aircraft have become a primary observing platform for upper troposphere/lower stratosphere (UTLS) field experiments in the past 5 years. It is through one of these field campaigns, the NASA Airborne Tropical Tropopause ExPeriment (ATTREX), that the author has received first-hand experience working with this aircraft. ATTREX is a five-year mission that aims to determine and quantify the physical processes that control the composition and humidity of air rising above the tropical tropopause and entering the stratosphere [1]. Through carefully designed flights that vertically profile the tropo-
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ical tropopause layer (TTL), the NASA GH is able to map out the chemical and dynamical structure of the tropical UTLS (see Figure 2). These aircraft observations allow evaluation of physical processes governing TTL composition and humidity from cloud scales (<100 m) to synoptic scales (>1000 km).

The first two deployments for the ATTREX campaign took place during October-November 2011 and January-March 2013, based out of NASA Dryden Research Flight Center (DRFC) located on Edwards Air Force base near Rosamond, California (the “high desert”). The latest mission for ATTREX is ongoing and based out of Guam in the Western Pacific. My participation in the campaign began during the 2013 deployment, when I spent three weeks in the field supporting forecasting and flight planning efforts for the GH.

My previous experience in field campaigns dates back to 2008, when I was a first-year graduate student and was fortunate to participate in a field project based out of NCAR’s Research Aviation Facility (RAF) in Broomfield, Colorado that employed the NSF-NCAR Gulfstream V (GV) aircraft to study atmospheric transport and mixing over North America. I quickly became enamored with field research during the campaign due to the fast-paced nature of aircraft observation and flight planning, which invigorated my interest in science. Flights were 6-8 hours long, took place 2-3 times a week, and initiated many interesting science questions and discussions. Having the opportunity to collaborate with many passionate scientists and be exposed to numerous scientific methods in the course of a few weeks was an incredible experience that challenged me to become a greater scientist than I had imagined up to that point. Since that time, I have had the opportunity to participate in several additional field campaigns that employed aircraft with capabilities similar to the GV, but this experience didn’t quite prepare me for working with a long-range UAV like the NASA GH.

For one, participating in 24-hour research flights with a UAV requires large quantities of caffeine and a certain flare of optimism. The dedication required of and exhibited by so many scientists, engineers, and additional individuals for completing such aircraft missions was truly inspiring for me as an early career scientist. Second, the base location of the mission certainly affects your productivity (being secluded on a military base more than 30 minutes from the nearest town feels a bit like living in The Truman Show). While on base for ATTREX, I often found myself opting to eat frozen dinners and doing research in my hotel room rather than taking the long trip into town to get a non-fast food meal (dining options are surprisingly limited on base). The most memorable part for me, however, was being able to watch a plane routinely ascend to near 20 km and descend to 14 km throughout the duration of the flight while traveling such large distances across the globe. This experience changed the way that I view science and the future of aircraft observation. Yes, there are certain limitations to UAVs, but a future where continuous monitoring of the global atmosphere is
possible could have profound impacts on weather forecasting and our understanding of the atmosphere.

References:

Cameron Homeyer is an ASP Postdoctoral Fellow working in the Atmospheric Chemistry Division. He came to NCAR from Texas A&M where he received his Ph.D. in Atmospheric Science.

Figure 2. ATTREX flight path on 5 February 2013.

Are Cover Letters Still Relevant?

As a postdoc, not only do you need to focus on your research and publishing results, you also need to focus a substantial amount of time on your job search. In the modern age of web applications and with the demands on your time, you may be asking yourself, “Are cover letters still relevant?”

David Jensen addresses this question in Science Careers. He argues that yes, they are. He writes, "...the cover letter still serves a purpose that no other part of your application package can serve: It makes a strong, upfront, specific case for your candidacy for the position. There's no better opportunity—at least until the interview—to point out a particular strength or hammer home the reasons you'd be an especially good fit for the position." He suggests that in cases where you don't have the opportunity to attach a cover letter in an online system, to send a formatted letter by email to an appropriate person on the hiring committee. After making the case for sending a cover letter, Jensen goes on in his article to provide some helpful ideas and exercises to help you create an effective letter using a three paragraph format.

The title of Jensen’s article is The Cover Letter: Relic or Relevant. The simplest way to find it is to type the title in Google. The link is http://sciencecareers.