LATITUDE
AN ENGINEERING GROUP

Project Summary for NASA NNX13CP29P

Relevance to NASA Mission

The ability to retrieve high altitude particulate and gas samples from volcanic plumes is a crucial task in assessing and evaluating the danger these plumes pose to aviation traffic. The economic impact volcanic eruptions may have on travel, commerce, and supply logistics is substantial as recently shown by the 2010 Eyjafjallajökull eruption in Iceland and the 2011 Puyehue eruption in Chile. Both events canceled hundreds of flights for weeks, leaving thousands of travelers stranded. While satellites provide valuable data to inform prediction models, they lack the ability to accurately estimate particle size and to determine how particles track with gases present in the plume. Collecting particle and gas samples is important to validate plume models and to determine the safety of flight for air traffic routes that may be affected by volcanic activity. Unmanned autonomous aerial vehicles (UAVs) hold great promise in performing in-situ sampling to assist with these efforts. Advanced guided dropsondes, and the NavSonde in particular, will have a significant logistic advantage as they will be regulated by the FAA as dropsondes and not UAVs. This will open up many research opportunities currently denied to most commercial UAVs and may make advanced guided dropsondes the platform of choice for conducting low-cost airborne atmospheric research.

Phase I Results

In this 2013 Phase I effort (NNX13CP29P), we developed an aerial sampler for an autonomously guided dropsonde called the NavSonde. Sized for the AVAPS sonde tube deployment system, the NavSonde is a low-cost, retrievable and reusable, autonomously guided dropsonde capable of deploying from a host aircraft and performing in-situ atmospheric measurements. In Phase I, we demonstrated that the prototype NavSonde is capable of being released from a manned host aircraft, articulate its wings into a flying configuration, recover from an unstable attitude, and autonomously glide to a pre-determined waypoint where it can be retrieved by a ground crew. While we fell short on time and were not able to demonstrate the functionality of the aerial sampler we designed for this effort, we did demonstrate the robustness of the NavSonde's design and construction as well as the survivability of the NavSonde's payload (e.g. sampler). The results of the Phase I have showed us that the NavSonde is a viable autonomous guided dropsonde platform. Combined with its aerial sampler, we are confident that the NavSonde will prove itself to be an innovative atmospheric research tool.

Phase II Continuation

Small scale particulate sampling equipment for airborne missions is not commercially available. Even for full scale manned systems, many research programs develop their own collection and sensor systems. A small form factor unmanned aerial sampling system, capable of being deployed from a host aircraft at high altitudes and autonomously guided to regions of interest will offer atmospheric scientists an innovative research tool–particularly for those seeking unprecedented access to high altitude atmospheric sampling to monitor events that may be deemed too dangerous for manned aircraft. Autonomously guided dropsondes have several advantages over current dropsondes–the main ones being their ability to fly to regions of interest and to perform pre-programmed actions at specified locations and/or altitudes (e.g. sample). Our proposed Phase II work will focus on refining and testing the sampler design--specifically in regards to its ability to control air flow and sample volume. We will also perform aerodynamic analysis work to improve the glide slope of the NavSonde. To validate the NavSonde and sampler performance, we propose to use weather balloons as the host vehicle to perform high altitude testing. Lastly, we will begin work on integrating the NavSonde into an aircraft equipped with an AVAPS deployment system. The products and results of Phase II are strategic steps towards achieving the NavSonde's true commercial potential as an airborne sampling tool.