#25 - Sustainable High-Altitude Launch Vehicle

Suborbital launch vehicles play an important role in understanding the upper atmosphere and the Earth's climate. These vehicles are particularly suited to upper atmospheric research, where neither satellites nor weather balloons are suitable. They are also an affordable and effective proving ground for new technologies before they are deployed in orbit, and a cheap way to access space and micro-gravity environments. Typically, suborbital launchers are expendable and use solid propellants that emit harmful exhaust products into the environment.
Project Altus aims to change this industry by developing a fully reusable and sustainable launch vehicle using novel technologies. The vehicle will demonstrate the technologies in the context of a mission to research Polar Mesospheric Clouds (PMCs), to deepen our understanding of the Earths climate and to study the effects of climate change.

Mission Objective

The objective of project Altus is to catalyse a shift towards sustainable space flight by means of a PMC research mission. This mission will demonstrate technologies that can be applied to reduce the environmental impact of launch vehicles.

System Design

The goal of the current mission is to collect long-term data on the formation and evolution of Polar Mesospheric Clouds. By flying multiple missions to the clouds, an extensive archive of samples and data can be established. This archive can be used to track cloud formation over time, in an effort to link the behaviour of PMCs to climate change and to other disturbances in the upper atmosphere, such as the exhaust products of large orbital launch vehicles.
To accomplish this mission, a two-stage launch vehicle using solid propellant is being developed. This vehicle is capable of carrying 12 kg of payload to an altitude of 110 km. The vehicle is equipped with a scientific payload which is deployed during the cruise towards the PMCs. The nose cone of the vehicle deploys, revealing the sample collection and suite of scientific instruments to the conditions of the mesosphere. Data is collected both during the ascent through the clouds and during the subsequent descent.
To facilitate the reusability of the vehicle, both the first and second stages contain parachutes and recovery hardware, allowing for the vehicle and the payload to return safely to the ground for refurbishment and reuse. The vehicle payload section is being designed to house the standard CubeSat form factor with a 6U capacity. This enables the carrying of a wide variety of payloads, including scientific payloads and CubeSat validation flights, all accommodated in a common payload housing and vehicle.
For this mission, the greatest area of development was to make the vehicle both sustainable and reusable. Research was performed to identify the propellant options that are commonly used. It was considered that these options would not meet the sustainability goals that were set. Therefore, a broader analysis took place, leading to a preliminary design of the Altus launch vehicle. A key innovation is the replacement of conventional ammonium perchlorate based solid motors, which produce 20% hydrochloric acid emissions by mass in their exhaust, with ammonium dinitramide-based propellants which completely eliminates this critical pollutant.