Post-Launch Assessment Review (PLAR)

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AIAA OC Section
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1 Recap: Launch Vehicle and Payload

1.1 Team name

AIAA OC Section

1.2 Motor used

CTI K661

1.3 Payload

The payload we utilized was a sensor that helped to track CO_2 levels based on altitude.

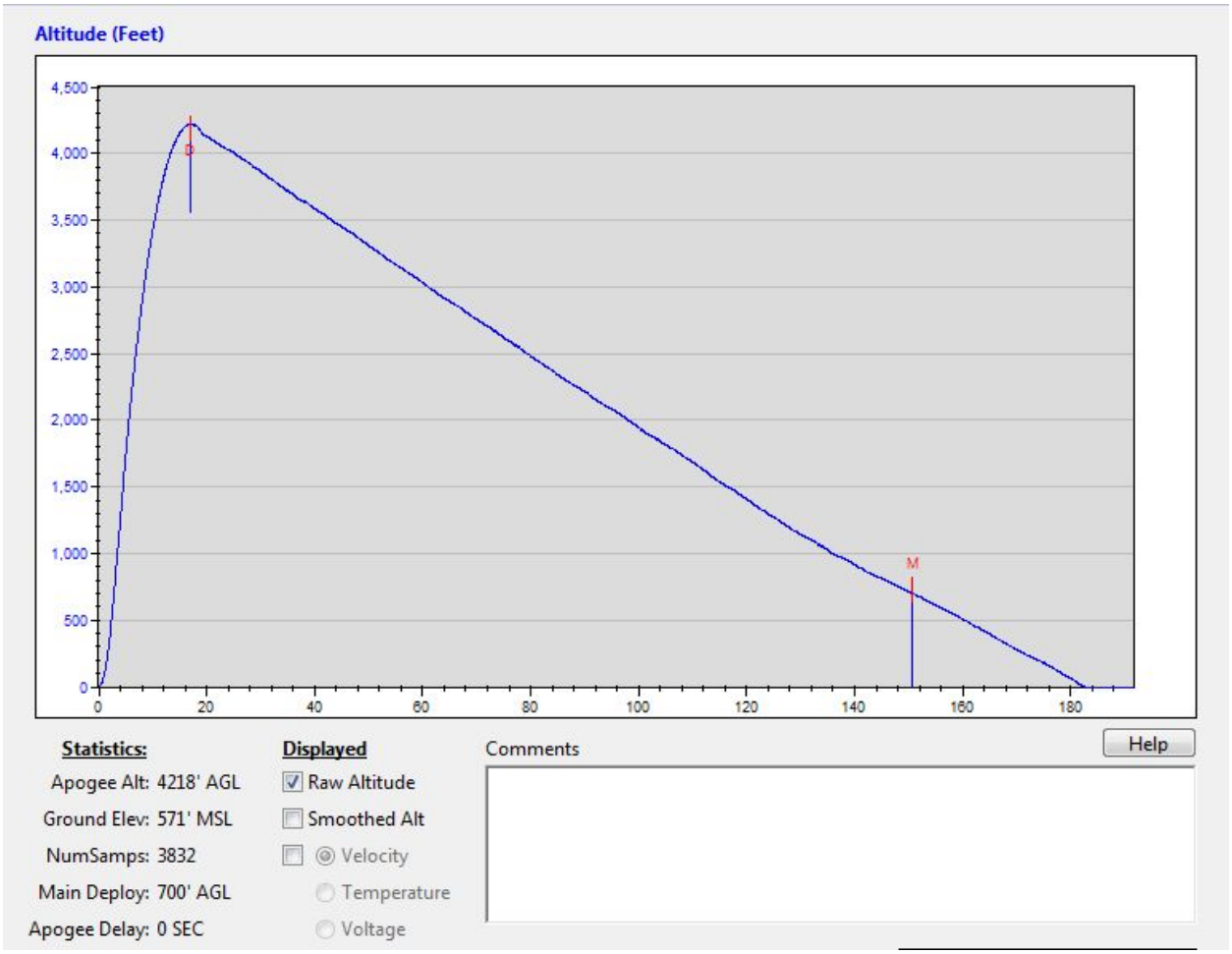
1.4 Vehicle dimensions

Vehicle Properties	
Total Length (in)	144.75
Diameter (in)	4
Gross Lift Off Weigh (lb.)	27.61
Airframe Material(s)	Fiberglass
Fin Material and Thickness (in)	Fiberglass
Coupler Length/Shoulder Length(s) (in)	Minimum is 4"

Stability Analysis	
Center of Pressure (in from nose)	105.3845
Center of Gravity (in from nose)	85.9246
Static Stability Margin (on pad)	3.33

2 Launch Review

2.1 Altitude Reached



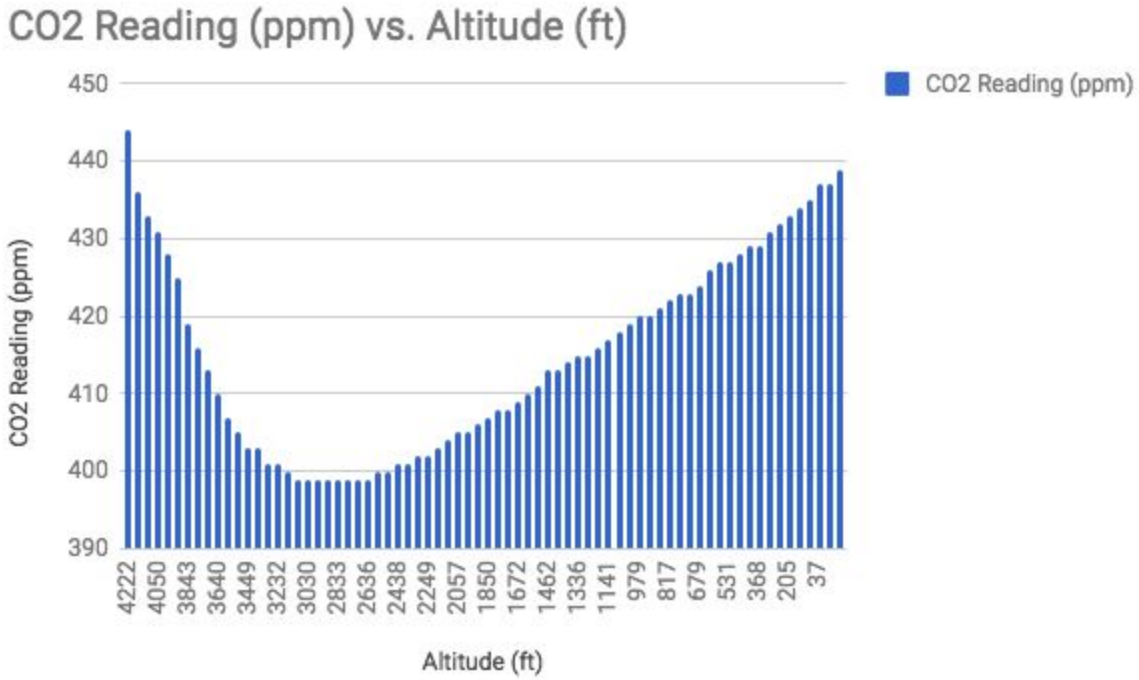
The altitude reached was 4218’ AGL.

2.1.1 Vehicle Summary

2.1.2 Data Analysis and Results of Vehicle

The flight reached an altitude lower than 5280 ft, or 1 mile, due to the rocket’s weight. Overall, the flight didn’t go as originally planned. First and foremost, the rocket carried an empty body tube as a result of payload changes for safety measures. Our original proposed payload was a UAV that tested the Magnus Effect and was controlled via RC. However, it wasn’t deemed safe

enough to fly and we proposed a change to the CO2 payload. The payload had been tested before and was intended to fly on last year's rocket, but due to a failure in the motor that caused our rocket to fly outward instead of upward, our payload didn't properly gather data. Since there wasn't enough time between the flight and our design issue to change the outer rocket, we had to fly with the empty body tube, where the UAV was planned to go. This increased the length and weight of the rocket in total. Secondly, our CTI K661 motor was selected with the intent of overshooting 1 mile high so we could use operating air brakes on board the flight. However, due to the weight of the rocket, the air brake module was vestigial and the electronics were taken out in an attempt to lighten the rocket. Third, during the actual launch, the drogue and main chute releases were somehow mixed up, so our main deployed at apogee while our drogue deployed at 700 feet. It is possible that the wiring was switched around during preparation, which was done in the very dim lobby of the Embassy Suites hotel in Huntsville, AL.



This chart plots the data collected by the payload upon the rocket's descent. It was unplanned to have the rocket descend at such a slow velocity, but the data is still steady.

- $\bar{X}$ = 415.083 ppm
- S_x = 12.88 ppm

2.1.3 Scientific Value

We had hypothesized that the payload would show that CO_2 decreases with altitude, but this is not the case. The chart displays exaggerated differences with CO_2, but on the whole, there is very little variation among the readings.

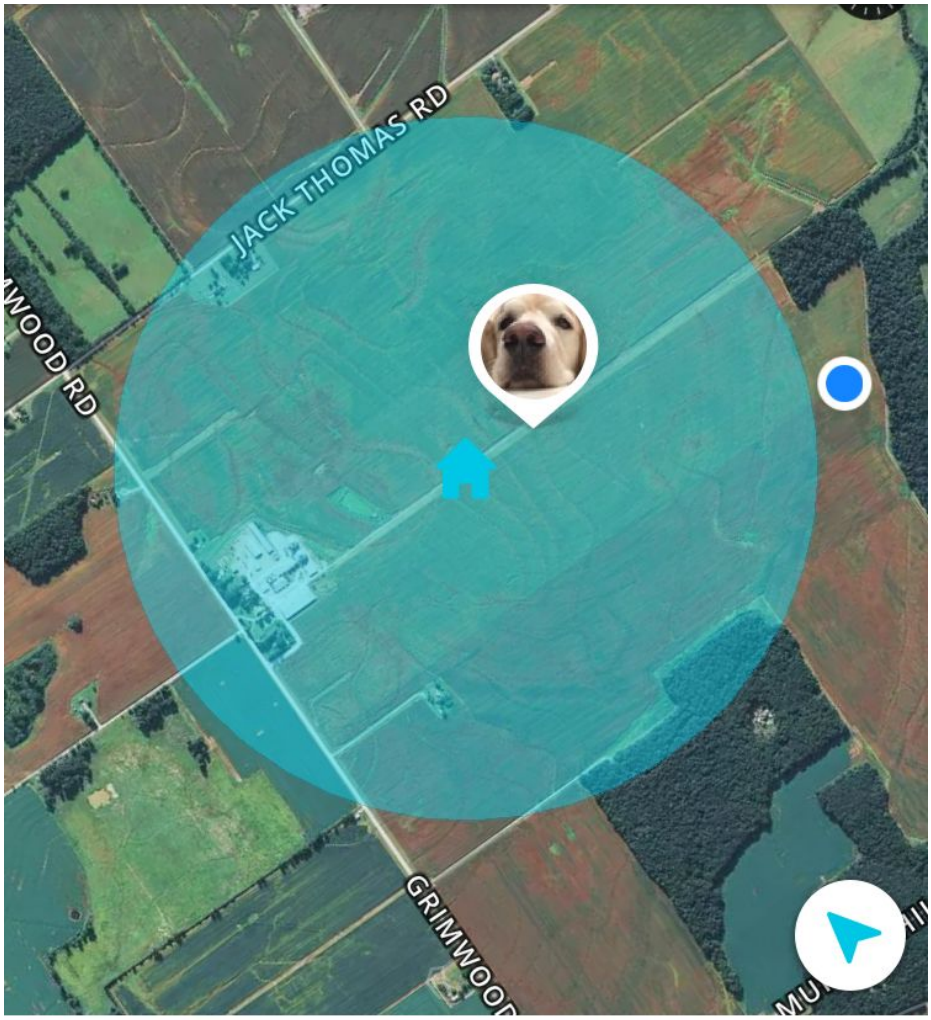
The data leads us to reject our original hypothesis.

2.2 Visual Data Observed

2.2.1 Overall Flight

As compared to our last year's flight, this year's was relatively straightforward. Visually during the launch, it was visible we didn't reach our 1 mile goal. In addition, the main chute and drogue chute releases were switched, as stated previously. Due to the early deployment of the main chute, our rocket was able to drift for longer, resulting in it landing about a mile (give or take a few) away from the launch pads, shown in the screenshot of the GPS app below.

2.2.2 Drift



This image displays the displacement of the rocket. The distance from the dog icon (the lauhch pad) to the blue dot (the rocket's location upon landing) is about 0.8 miles.

3 Hindsight

3.1 Lessons Learned

- Don’t procrastinate
- Account for weather and get a launch ready ASAP
- Set multiple deadlines/check-ins ahead of the actual deadline to account for time to fix/change errors.
- Make sure everything is labelled on the rocket

3.2 Summary of Overall Experience

Three of the four members on this team were seniors. We very quickly learned that college applications would interfere with our work in Student Launch.

The payload we had set out to build, a UAV that utilized the Magnus effect to generate lift, was going to be extremely difficult. Not only did the diameter of the rocket limit our ability to create a suitable cylinder size for the UAV, but there was also the issue of development. There weren’t set deadlines for the production of the UAV, and there were manys setbacks due to our inexperience. We learned how to build RC vehicles really late in the process, which prevented us from developing a UAV that could safely descend at our launch in Huntsville.

4 Educational Engagement Summary

The activity that was set up was launching paper rockets using pressurized air and a penny as weight at the tip of the rocket. There was one person guiding the launches and another watching over the range and the participants waiting to launch to ensure their safety and keep order. The participants would cut out and fold their own rockets. They had the ability to decorate to their will. For the younger participants, we had already cut out rockets that they could fold and customize. Once they were ready, they waited in an orderly fashion to be allowed onto the launch pad to load their rockets. Once the range was clear and the participants were back at the control pad, they were able to countdown and launch their own rocket using pressurized air.

5 Budget Summary

Description	Unit Cost	Qty	Subtotal	
Scale Vehicles and Engines				
3" Fiberglass Frenzy XL	$200.00	1	$0.00*	
3" G12 Thin-Wall Airframe (12" length)	$20.00	1	$0.00*	
3" G12 Coupler (6" length)	$14.00	2	$0.00*	
3" G12 Coupler (9" length)	$21.00	1	$0.00*	
HS-7980TH	$190.00	1	$0.00*	
2-56 wire	$10.00	1	$0.00*	
1/4" Machine Closed Eye Bolt	$18.00	4	$0.00*	
Heavy unit easy connector	$5.00	1	$0.00*	
Iris Ultra 72" Compact parachute	$265.00	1	$0.00*	
12" Elliptical Parachute	$47.00	1	$0.00*	
Body Tubes and Bulkheads	$134.69	1	$134.69	
Cesaroni J210	$68.00	2	$136.00	
Total Scale Vehicle Cost				$270.69
Vehicle				
4" G12 Coupler (12" length)	$31.00	3	$0.00*	

4" G12 Coupler (8" length)	$21.00	2	$0.00*
4" Fiberglass Frenzy XL	$300.00	1	$0.00*
4" G12 Airframe (12" length)	$23.00	1	$0.00*
2-56 wire	$10.00	1	$0.00*
Heavy unit easy connector	$5.00	1	$0.00*
Aero Pack 75mm Retainer (Fiberglass Motor Tubes)	$44.00	1	$0.00*
Shock Cord Protector Sleeves of Kevlar	$10.00	3	$0.00*
1 Inch Black Climbing Spec Tubular Nylon Webbing	$12.00	2	$0.00*
3/8" Machine Closed Eye Bolt	$30.00	4	$0.00*
4" G10 Airframe Plate	$6.00	8	$0.00*
3" G10 Airframe Bulkplate	$5.00	8	$0.00*
3" Aluminum Bulkplate	$15.00	4	$0.00*
4" Aluminum Bulkplate	$20.00	4	$0.00*
4" Coupler Bulkplate	$4.00	4	$0.00*
3" Coupler Bulkplate	$3.50	4	$0.00*
Electric Matches	$1.50	60	$90.00
Aero Pack 54mm Retainer (Fiberglass Motor Tubes)	$29.00	1	$0.00*
Body Tube and Bulkhed	$144.39	1	$144.39

Eyebolts	$80.78	1	$80.78	
4" Coupler Bulkhead		4	$21.81	
Launch Rail	$29.63	1	$29.63	
Tape Measure/Tweezers	$28.47	1	$28.47	
Cesaroni K2661	$133.00	2	$301.00	$35 shipping
Total Vehicle Cost				$696

Recovery

Iris Ultra 120" Compact Parachute	$504.00	1	$0.00*	
24" Elliptical Parachute	$60.00	1	$0.00*	
4F Black Powder	Kept by mentor			
Batteries (9v, 2 pack)	$7.00	3	$0.00*	
Battery Holder	$1.00	5	$0.00*	
Stratologger CF Flight Computer	$55.00	1	$0.00*	
RRC3 Flight Computer	$70.00	1	$0.00*	
PerfectFlite Pnut (2 units)	$55.00	2	$0.00*	
Locing Connectors, Housing Kit, Shunts, Heat Shrink Tubing	$42.47	1	$42.47	
100 3mm Led Lights	$3.99	1	$3.99	
Voltage Regulator	$5.03	1	$5.03	

Capacitors, Cables, Breadboard Diode	$11.67	1	$11.67	
Total Recovery Cost				$63.16

Payload

Arduino Uno kit (includes LED, resistors, regulators, etc)	$35.00	1	$0.00*
SD card + Adapter + Teensies + Headers	$102.09	1	$102.09
PerfectFlite Pnut Altimeter	$50.00	2	$0.00*
Lithium Ion Battery (rechargeable)	$100.00	1	$0.00*
DC 12v 10000RPM Mini Magnetic Motor	$5.53	2	$10.06
16” Paper parachute	$4.00	2	$8.00
Gimbal	$11.68	2	$23.36
Adafruit Battery	$6.40 for 10	10	$6.40
Arduino Mega	$44.95	1	$44.95
Carbon Fiber Round Tubes (6mm x 5mm 1000mm)	$27.44	1	$27.44
two-chanel Transceiver and Receiver	$120.00	1	$120.00
40PCS Dupont 10cm Male to Female Jumper Wire	$1.24	1	$1.24
HP-PRO Short-167 Low-Profie HV Digital Servo	$67.99	1	$67.99

Gears/Rod/Bearing/Fasteners/Fishing Lines	$129.36	1	$129.36	
Stretching Band	$7.53	1	$7.53	
Resistance Rubber Loop Bands	$14.00	1	$14.00	
Linear Actuator 30 mm 50-6	$228.61	1	$228.61	Express Shipping
Motors - 10000 RPM	$11.92	1	$11.92	
3.7" Body Tube	$11.00	2	$36.88	14.88 Shipping
KST x 12-508 Micro Corelss HV Servo	$68.48	1	$68.48	
Transmitters and Receivers - Argent	$181.07	1	$181.07	
100 pack 4.7K ohm 1/4W Metal Film Resistor	$2.29	1	$2.29	
Standoff Spacer for PCB	$24.17	1	$24.17	
Swivel Pulleys	$18.30	1	$18.30	
Double Indulator Single Row Header Strip	$9.98	1	$9.98	
5 mm Drill Bit	$9.97	1	$9.97	
Solder Wire	$14.99	1	$14.99	
18 AWG Cables	$10.98	1	$10.98	
Heat Gun/Super Lube/Laminator	$52.03	1	$52.03	
Weather Balloon	$28.45	1	$28.45	
Total Payload Cost				$1,260.54

GPS System

Whistle GPS Dog Tracker Kit	$75.00	1	$0.00*	
Whistle Monthly Charge-Jan	$9.95	1	$9.95	
Whistle Monthly Charge- Feb	$9.95	1	$9.95	
Cellular Service Fee (3 months free, 5 months to pay)	$40.00	1	$40.00	
Total GPS Cost				$59.90

Educational Outreach

Color fliers (250 copies)	$170.00			
Total Educational Outreach Cost				$170.00

Travel (4 Members)

Trips to Lucerne ($2.80/gal, 112mi; $21.00 per trip per car)				
Huntsville, Alabama (roundtrip plane ticket)	$332.00	6	$1,992.00	
Food (2 meals a day, 6 days)	$10.00	728	$720.00	
Hotel (2 people per room, 6 days)	$120.00	18	$2,160.00	
El Centro Hotel	$99.18	7	$694.26	

Total Travel Cost (Estimated)	$5,566.26
Total Estimated Project Expenses	$8,086.63

*Materials from previous year