Building the weather balloon with the limited budget and observing the state of atmosphere both visually and statistically

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Abstract

Within the limited budget, we constructed the weather balloon, then launched it into the sky from Orange city to observe the condition of the troposphere and stratosphere. While we could not collect the balloon and the data after launching it, the experiment benefited us by learning and building our own scientific thinking. The materials of the balloon were bought from Germany. The weather balloon's main body, which contained electronic devices for measurement and communication with the ground, was made of typical Styrofoam. And the main body was connected to the balloons, which continued the helium gas. The parachute was attached between the balloons and the Styrofoam box. So, the balloon was modeled to descend gradually with a parachute after the balloon burst at a certain altitude. The launching day was January 6, the temperature was 10 F°, and the wind was blown to the Northeast at 6.2 mph. After launching, the electronic device and the weather balloon's communication was established in only the first 20 minutes. We also tried to take a video of the environment outside of the earth. The video might be good for the advertisement of NWC. However, since we could not collect the balloons which we launched with GoPro7, we could not check the sight.

Introduction

As modernization is going on, people fully rely on our technology, and it maintains enough accuracy for us to use in daily life. But, as college students, we are concerned that it is possible to measure the actual temperature, pressure, windiness, or humidity from the satellite, which is way above the troposphere. As the creation of God, we know the universe, including the earth, is very organized by the combination of a lot of laws. And science derives many formulas based on nature. Because the meteorological agency and the nation believe that the formulas are so accurate, modern society only uses the information from satellites, then derives the weather information at each location. But as many scientists and philosopher insists, humans tend to over-trust modern technology. Weather balloons, an old type of measuring the sky information, give us the inflation of only one point. But in other words, they measure the weather information of each altitude directly, so the observers can notice what the actual transition of the sky condition looks like as the balloon rise its altitude gradually. So, we hypothesize that if we compare the weather data deriving the formula with satellite information and the weather balloon's data, we would be able to evaluate how human stereotype separates us from the natural truth. An Also, taking the video of the sky, which is attached to the balloons, should promote the student's desire to study physics. We hope the great and beautiful picture of the sky or earth from the perspective outside of the earth adds small joy to our education.

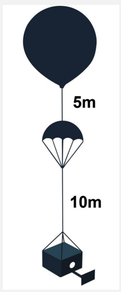
Discussion

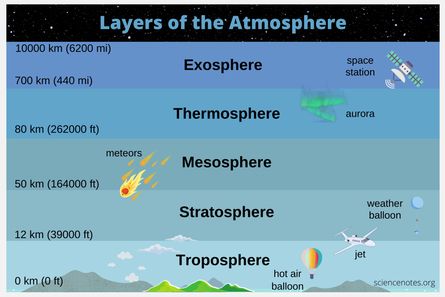
While we could build our original version of the weather balloon, we could not get the actual data from the balloon except for the first 20 minutes, and we could not re-collect the balloon and materials. While there are a lot of factors to make the consequence, the biggest issue was that we could not use the accurate GPS tracker for the balloon to communicate on the ground. We should have pre-evaluated more carefully about the devices to determine whether this is compatible with the severe environment which comes from a high altitude. Also, while we thought we did enough simulation and calculation to determine the amount of helium we needed, the gas was not enough to fulfill the whole balloon's volume. As a general rule, if the temperature is severely low, the volume of the helium gas shrinks, so we might need the helium gas more than we expected at the standard temperature. Also, we ordered only the amount of gas that we expected. It means we only ordered 20 L of the gas if we expect we need 20 L to fulfill it. We should have ordered the extra amount of gas just in case. Also, the temperature might be too cold to launch the balloon with some precision machine. Of course, we could put a heater on the side of the machine. However, if we contain the machine to generate the heat in the box, it might affect the measurement of the sky conditions. So, it was not a problem that we could solve easily. However, we could learn how scientific and logical thinking is essential to succeed in research, and the required level which is required is way beyond our expectations. Without this research experiment, we would not be able to realize that. Also, the research promoted our curiosity about the natural world and passion for learning more about the world from the physics perspective. While this experiment is concluded here, the foundation of scientifically thinking, which we learned in this experiment, is continuously helping each member's different research, which is currently progressing.

Planning

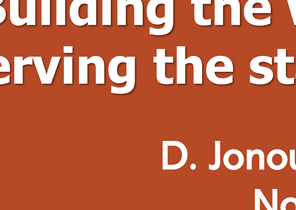
The plan was to take a video with a camera in front of a card that says: "Stratosphere Project by Aimee, Tim, Daiki" instead of the teddybear. And we planed to launch up with NWC logo instead of teddy bear.

Also, with using the observational instruments, we tries to visualize the transition of changing the temperature, humidity, pressure as the altitude increase.

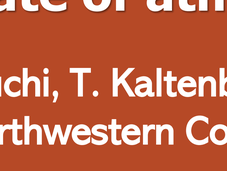




Results: Making the weather balloon

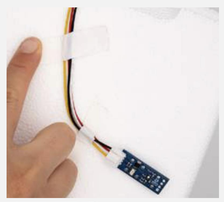


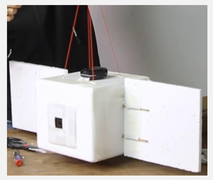
Put the camera in the box to take the video off earth.



The wing on both sides is to control the body and make the lift power

GPS is fixed at the inside of the box.

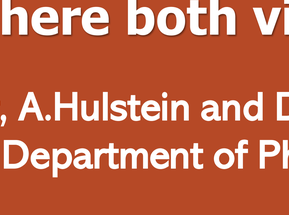


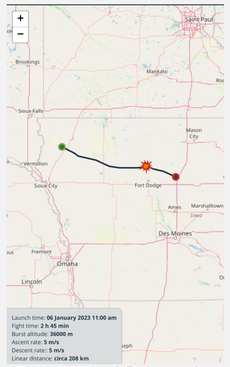


The body of data logger is placed in the inside of the box, but the sensor need to be attached on the outside of the box.

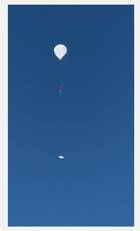
Results: Launching

We brought the materials of balloon and helium tank for the launching point (4152 Albany Ave NE)





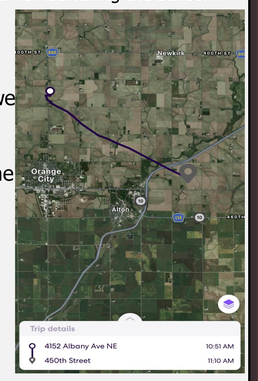
Our expected flight path



Results: Analyzing the data

The weather information of the day when the research is conducted. From the evidences of temperature, wind, and cloud coverage, the conditions of the day was suitable weather for launching the balloon.

The record of GPS tracker. While we could communicate first twenty minutes with the balloon, we lost the whereabouts of it. However, the data proved that the balloon were moving to the South east. The direction was almost same as we expected.



The theoretical speed of the balloon was

$$\frac{249448m}{165minutes * 60s} = 25.83m/s$$

The actual speed of the balloon was

$$\frac{12874m}{19minutes * 60s} = 11m/s$$

From the data, there is high possibility that the balloon was landed much closer to Orange city than we expected.

References

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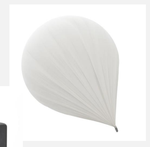
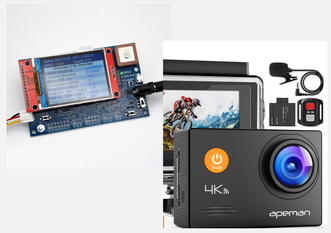
- **Launching balloon protocol**
- **Weather Balloon, 1600,**
- **Parachute 800 or 2500**
- **GPS Tracker STRATOfinder**



Material

- **Data logger**
- **Batterypack**
- **Polystyrene Probe**
- **Gloves, 2 Pairs**
- **Tesa duct tape**



<Student researchers>