Elijah X Mission Report

Flight name: Elijah X

Flight radio call sign: KC9EJY

Launch site: University of Wisconsin – Eau Claire

Latitude: 44.819

Longitude: -91.479

Altitude: 211 meters

The launch of Elijah X by the WSGC team was 80-90% successful; not being a 100% success at this point due to not having yet recovered the payload. We are continuing efforts to find the payload and are using many resources to do so.

Summary of Balloon Launch

The preparation and launch of Elijah X went beautifully. We arrived on the UW-Eau Claire campus at 3:30am. The balloon was set up early in the morning in order to take advantage of the favorable wind conditions that accompany sunrise. Preparation for the launch began at 3:45 am on UW-Eau Claire's athletic field. The weather conditions were about as perfect as we could have asked for, having hardly any wind and very few clouds. We released the balloon at 6:15 am. Video coverage and still digital shots of the entire process were taken, including the chase and search for the payload that followed. The first indication of a problem came when the balloon reached approximately 50,000 feet. At that point the laptop, receiving information from the balloon, stopped responding and had to be reset. Restarting the laptop and reestablishing contact with the balloon took time and as a result the chase vehicles were unable to stay underneath the balloon. Based on predictions made (Appendix A) we traveled east to try and stay under the balloon. Contact with the balloon was reestablished as the balloon ascended to 102,000 ft. We then realized we were 12 miles northeast of the balloon. Contact with the balloon was lost as the software stopped responding and the system was again restarted. We then headed in the direction of the last coordinates and reestablished contact at 42,000 ft during the balloon's descent. Our final reading was taken at 20,192.7 feet while we were still approximately 7 miles away from the balloon.

From the final readings we were able to estimate the landing site of the balloon to be roughly five miles from the last reading in the southeast direction. This was determined from the speed, location, and direction the balloon was heading from the two final data points.

Problems Encountered

- Lost radio contact with the balloon and were unable to receive GPS information
- Difficulties reestablishing communication with the balloon
- Unable to effectively track the balloon in the air once radio communication was lost
- Unable to effectively find balloon on the ground without exact GPS coordinates
- Final prediction from BalloonTrack software was inaccurate

Why Problems Occurred

Lost radio contact with the balloon and were unable to receive GPS information

We have determined at this point that the reason for losing contact with the balloon was due to an overload of information coming to the laptop, causing the APRSPoint tracking program to freeze. The APRS network consists of hundreds of ham radio operators in the Eau Claire area. The laptop was set up to receive all the transmissions on this network, which includes the balloon as well as other ham radio operators. The pattern was that when the computer reached approximately 60 packet transmissions, it crashed.

We had been working with the APRSPoint tracking software for more then three weeks prior to the launch of Elijah X and had never experienced similar difficulties with the program. The overload of data being received by the program is most likely the result of being in Eau Claire where we received a substantially larger amount of packet transmissions.

Difficulties reestablishing communication with the balloon

There was a substantial amount of time that passed before we could gain communication from the balloon after the computer crashed. The computer rebooted everything in a few minutes, but it would take 20-30 minutes to reestablish communication. This was due to the power being output from the radio in the balloon. We tested the balloon at 5 Watts of output power, but because of battery life issues we set the radio on a lower setting of only ½ Watt. Therefore the signal was much smaller and when we fell out of its shorter range it was more difficult to communicate with.

Unable to effectively track the balloon once radio communication was lost

We had two tracking teams, one who focused on following the balloon based on GPS and one who focused on keeping visual contact. Being that the balloon began traveling east into the direction of the rising sun it was very difficult to maintain visual contact. Also, the only thing we could see was the actual balloon once it reached about 40,000 feet. Finally trying to keep visual on such a small object becomes exceedingly difficult and dangerous in a moving vehicle.

Unable to effectively find balloon on the ground without exact GPS coordinates

Not being to effectively locate the balloon on the ground without the aid of GPS was a problem that we did not consider during our original design. We always assumed we would at least have coordinates close to the ground and a possible visual on the balloon as it descended. We also did not suspect that the forested area would be quite so dense and difficult to see through.

Final prediction from BalloonTrack software was inaccurate

There was a high-pressure system that passed over Wisconsin and a chance for rain the night before the launch. This may have affected the data on wind speeds we received from Chanhassen the night before the launch. The final prediction was almost a due east route. The first two predictions resembled more closely the actual flight of the balloon.

Solutions

Lost radio contact with the balloon and were unable to receive GPS information

1. There is a filtering option associated with the APRSPoint software. This limits what call signs you will receive information from. If this option is used, this itself will probably prevent the flooding of information.

2. Only having one laptop running the software was also probably a fatal decision. We plan on having two (possibly three) systems set up to communicate with the balloon. Because anyone with ham radio equipment, who is in range, can receive the information from the balloon. Therefore the number of systems running is only limited by budget.

Difficulties reestablishing communication with the balloon

1. We plan on building a different power supply for the radio in the balloon that will enable it to output its maximum 5 watts of power.

2. The multiple laptops will also aid in not losing the connection.

Unable to effectively track the balloon once radio communication was lost

1. We plan on adding brightly colored streamers to the lower payload as well as a reflective surface to the payload.

2. We are also thinking about having a stationary team with a telescope and other spotting equipment and watch the balloon from beginning to end. This team could either be in the launch area on high ground or near the estimated landing site looking for the balloon after it's in the sky.

Unable to effectively find balloon on the ground without exact GPS coordinates

1. After talking with the search and rescue team, we are considering using a radio device that would output every few minutes on an unused frequency; a radio beacon.

2. We are also designing a device that will set off a smoking devise every half hour after landing. This will create a cloud of smoke around the landing site and can then be more easily spotted from a distance.

3. Outputting more power from the radio will also aid. Testing in the city has shown that a four mile range is possible through trees and buildings.

4. A more brightly colored payload will also help.

5. Lights, incase it cannot be spotted during the day, a strobe light, or covering the payload in bright LED's may aid with the aid of night vision.

Final prediction from BalloonTrack software was inaccurate

1. We plan on simulating more launches based on more wind information from around the state. We plan on simulating flights for 10 days prior to the flight in order to look at a variety of information. We also plan on gathering wind information from Chanhassen as well as Green Bay and a southeastern location to look at information from around the state to get a better approximation of wind speeds and balloon travel.

Conclusion

The successes of the flight cannot be overlooked. The launch procedure went smoothly and was one to be proud of. For never having performed a launch to this point, or even having witnessed one, the team performed exceptionally with only five members to complete the process and successfully launch the balloon. The balloon performed exactly as expected. It took approximately two hours to ascend, one hour to descend, and reached the target altitude of 100,000 feet. We know this to be true because we received a data signal from the balloon when it was at 102,000 feet. This further proves that the cold temperatures at this altitude did not affect the capability of the equipment.

Launch Timeline & Events

Before Sunday:

- Three simulations using balloon track are preformed (Friday evening, Saturday morning, and Saturday evening) importing data received from Chanhassen into the Balloon Track software. The predicted paths of travel are attached in Appendix A.
- All equipment is tested Saturday evening before leaving.

Sunday 3:45am:

- Setup begins on UW – Eau Claire's athletic field.

5:40am:

- All electrical equipment is turned on tested and placed in capsule.
- Balloon is being filled.

5:50am:

- Equipment in capsule is weighed (6 pounds) and balloon is filled to two extra pounds of lift (8 pounds).
- Payload is attached to parachute and balloon and prepared for launch.

6:10am:

- Balloon is launched and tracking begins.
- Receiving data from balloon approximately every 3 minutes.

6:40am:

- Visual contact with Balloon was lost.

6:52am:

- Transmission from balloon is lost when software on laptop freezes. Laptop had to be reset in order to get the software to function correctly again.
- Last transmission was at approximately 50,000 feet and heading east.
- Location of balloon is lost.
- We decide to regroup and assume the balloon is going to follow the predicted path and fall near the predicted landing site.

8:01am:

- We receive a transmission from the balloon at approximately 102,000 feet, heading 255 degrees (southwest) and traveling at 30 knots. Coordinates are 44.44583 latitude and -91.05316 longitude.
- We realize the balloon traveled much more south east, closer to the path predicted by the first two simulations.
- We are now approximately 12 miles from the balloon and begin to head toward the final transmission coordinates.
- The software freezes again almost immediately after receiving the transmission from the balloon and the computer is reset again.

8:37am:

- We receive another transmission at 42,000 feet during the descent heading east from the 102,000 foot position.
- We are still 8 miles from the balloon and heading south west.

8:48am:

- Final transmission is received at 20,192.7 feet. Its heading was 92 degrees (almost due east) and traveling at 33 knots. The final coordinates were 44.3055 latitude and -90.81533 longitude.
- Current road we are on is closed and we take a 2 mile detour west.

9:30am:

- We arrive at the final transmission location.
- We determine from the last two transmissions that the descent rate was approximately 2000 ft per minute, heading east at 33 knots. We determine that there is a five mile radius to search in. We also extrapolate that the payload is most likely in the southeast area of prediction.
- Begin to search by sight and sound hoping to receive radio transmission.

Elijah X Predictions

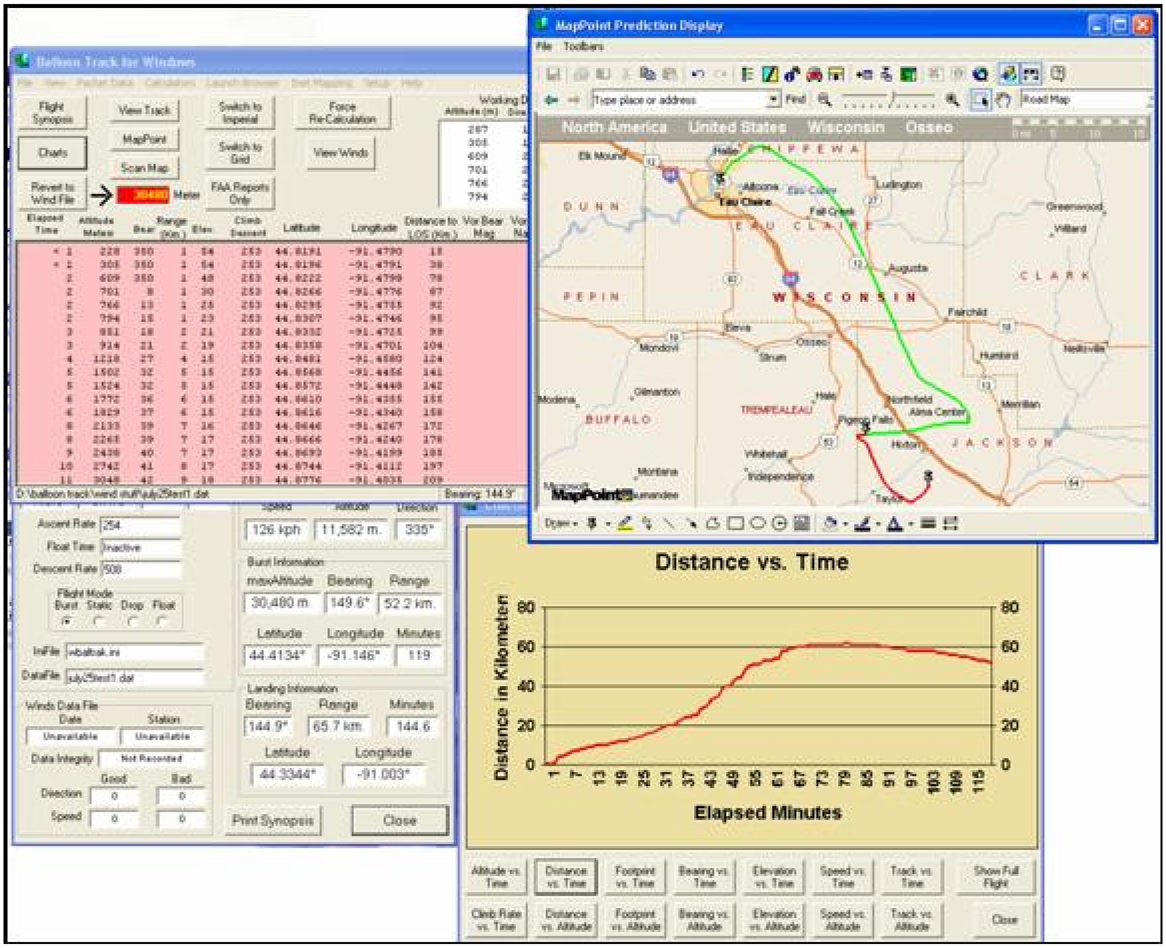

Figure 1: Screen capture of predicted path based on weather reports from Chanhassen on July 25.

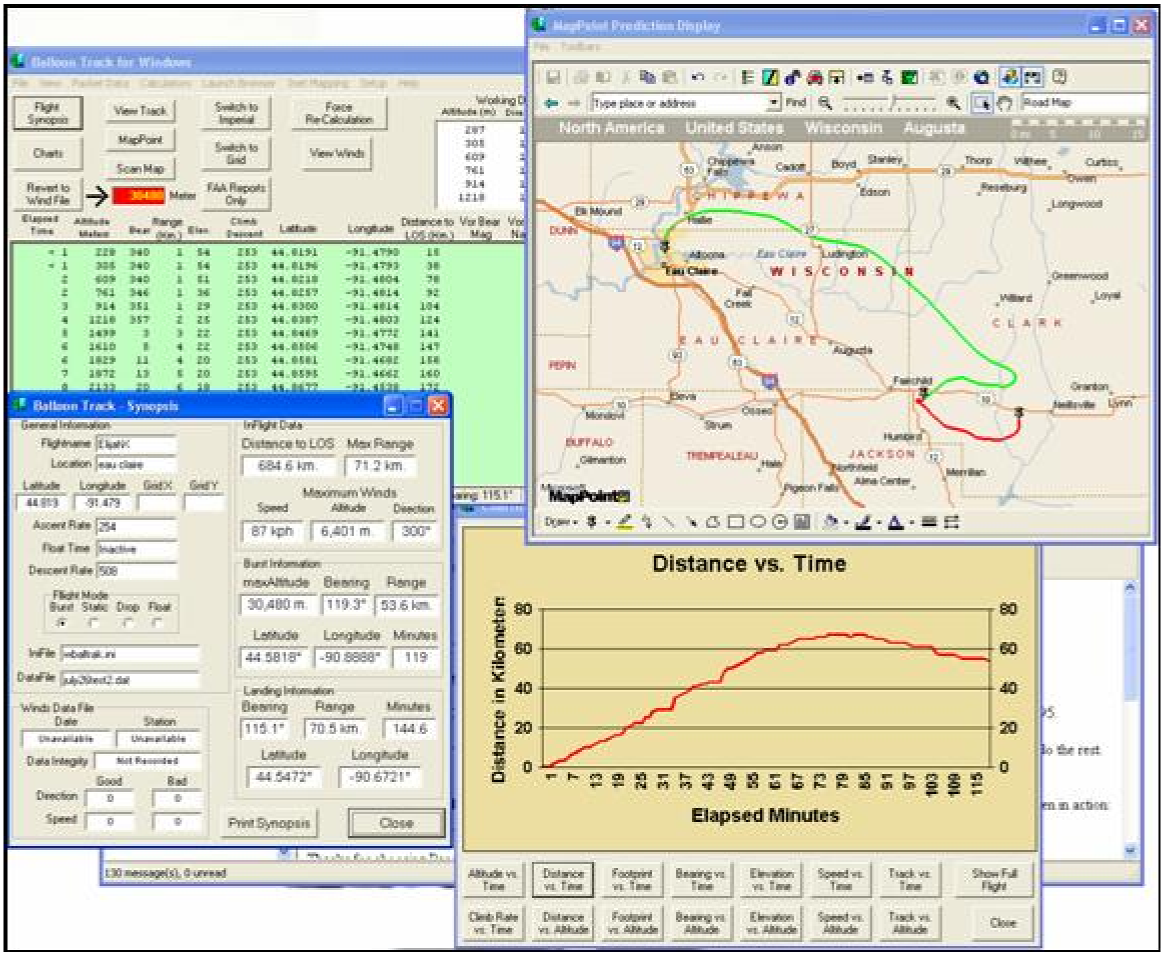

Figure 2: Screen capture of predicted flight path based on weather reports from Chanhassen on the morning of July 26.

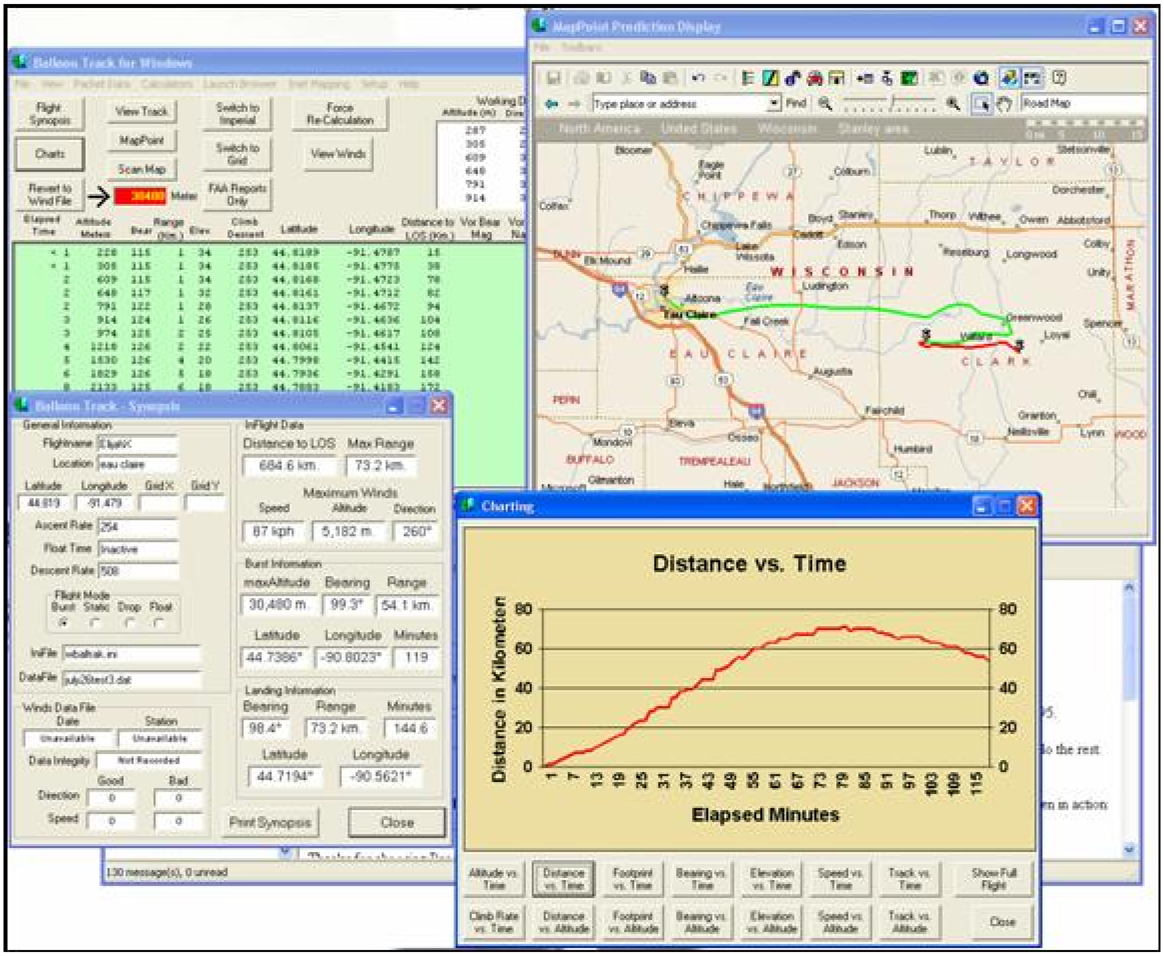

Figure 3: Screen capture of predicted flight path based on weather reports from Chanhassen on the evening of July 26.