Impactful Practice: Lessons Learned Through Ballooning Outreach

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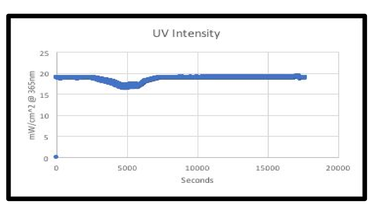
BACKGROUND

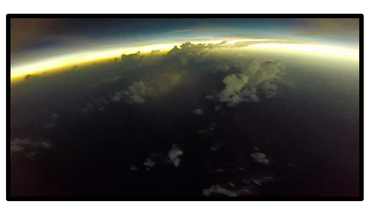
Bluegrass Community and Technical College's (BCTC) BalloonSat Project began two and a half years ago at Marshall Space Center. We have trained more than 20 students to design, build, and fly balloon-borne atmospheric data collection payloads on over a dozen full and tethered launches. We were excited to partner with NASA's Eclipse Ballooning and MicroStrat Projects during the Great American Eclipse of August 21st, 2017.

PAYLOAD DESIGN

Our design team built and tested several iterations of balloon payloads before settling on a flight train comprised primarily of styrofoam spheres. These not only cut down on wind resistance and stabilized our images, but provided a secure housing for sensitive equipment in the event of a rough landing. Launches were monitored in real time using redundant systems including APRS, Iridium, and multiple SPOT trackers.

DATA COLLECTION

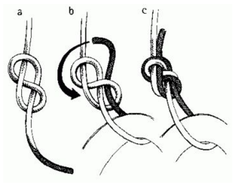


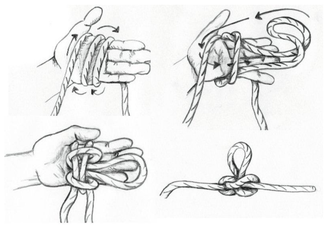


Flying within the umbra of the Great American Eclipse afforded us a unique opportunity to measure the decrease in ultraviolet radiation during totality. The graph above shows the decline in UV intensity measured at 365 nanometers.

FLIGHT LINE KNOTS

A **Figure-8 Follow Through Knot** (right) works very well for most securing applications. The knot is relatively easy to tie and will not slip under load.



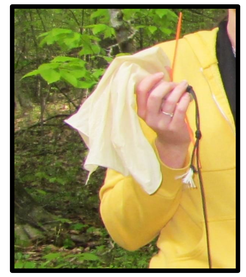


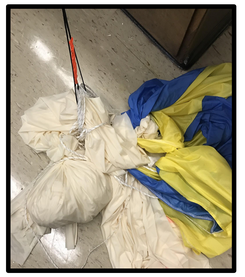
The **Alpine Butterfly Knot** (left) works well for attaching payloads to the flight train. This knot can be easily tied and positioned in-line along any point in the system.

Our team was able to draw on a unique wealth of knowledge when it came to tying and securing knots. Several members of our team had previous tying experience in the US Navy and Kentucky Search & Rescue Teams. Knowing which knots to use and which *not* to use was essential, particularly in the tense moments before flights with narrow launch windows. Secure attachment of both balloon and payloads can make the difference between success and failure of your launch. The initial tension on the payloads during launch and in flight due to high stratospheric winds will increase the strain on the knots far beyond that experienced with just the static weight of the payloads. Knots should always be tested prior to relying on them in flight.

BCTC's BalloonSat team members have achieved remarkable results over the years by using unconventional means to retrieve valuable hardware after tricky landings.

BALLOON SIZE

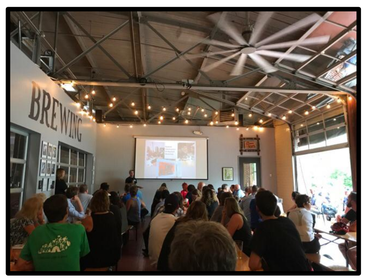




After balloon burst, a large amount of latex residue at the end of the leader line can interfere with descent and endanger payload survivability. The added weight and potential for entanglement from an incompletely disintegrated balloon can negatively impact parachute deployment and system recovery in a variety of ways. Our launch experience has taught us that the most robust balloon may not always be the best choice for a flight.

The 2000 gram balloon pictured in the above-right photo left a considerable amount of residual latex after burst. It tangled with the parachute which lead to descent speeds above 50 MPH. Our team found that with a 1600 gram balloon (above-left photo) there was far less residual latex after burst. The 1600 gram balloons have been able to carry up to 12 lbs of payload and have reached over 100,000 feet before burst on a regular basis.

COMMUNITY OUTREACH



In addition to conducting several public education events in the lead up to the eclipse, BCTC BalloonSat team members cultivated a robust relationship with Fayette County elementary and middle schools. Team members delivered presentations on eclipse science and high altitude ballooning to the students and encouraged them to get involved by designing their own experimental payloads which were flown on our test launches.

A major challenge of coordinating with the public school system was getting students access to our launches. Bussing students to the launch site was cost prohibitive and their classroom computers often block the same social media websites which we use to live stream the launches (Facebook Live, YouTube, Stream, etc.). In the future, we hope to collaborate with local news crews to provide a live broadcast of our launches on public access tv stations and websites which are not blocked from classroom viewing.

www.bctchab.org - **Project supported by NASA Kentucky, KY EPSCoR, and Montana Space Grant**