



Promoting Science and Education through  
High Altitude Balloons and Amateur Radio

**PPRAA Ham Radio Megafest**

**July 8, 2006**

**Monument, CO**

- **Russ Chadwick, KB0TVJ**
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- [russ@wxqa.com](mailto:russ@wxqa.com)
- <http://info.aprs.net> , APRS Uses,  
High-Altitude Ballooning
- Much of the content here assembled  
by Larry Noble, N0NDM



# What Is EOSS?

- Founded January 1991 as a Colorado educational non-profit corporation 501(c)(3)
- Charter:
  - **Promoting Science and Education Through Amateur Radio and High Altitude Balloons**
- “The Poor Man’s Space Program”
  - **Payloads to above 99% of Earth’s atmosphere and back for \$200 to \$500**
  - **Provide student groups firsthand experience with science and technology to the edge of of space**
- Funded by donations and 60+ memberships
- Affiliated with ARRL

# Application of Ham Radio

## ■ Balloon-borne radios:

- GPS-based location, mapping and altitude (APRS)
- Live television (ATV)
- Cross band repeater (400 mile radio horizon)
- Experiment telemetry
- Flight data and cut down command
- Radio Direction Finding (RDF) beacons

## ■ Ground applications:

- Meetings on the air (Nets)
- Launch and landing site talk-in
- Balloon prep and ground station coordination
- Track and recovery team coordination
- Balloon tracking via RDF and APRS
- Ground station / T&R team status reporting

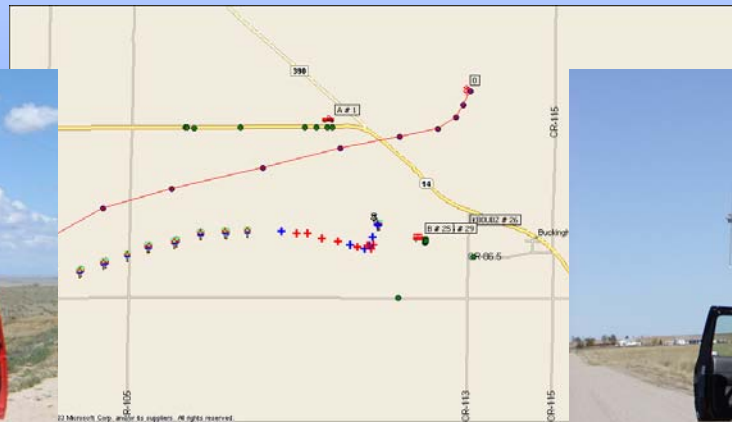
# Educational Activities

- **Contribute to schools' technology programs**
  - Classroom presentations, middle school thru college
  - Payload design and construction



# Operational Contributions

- Launch site and ground station operations
- Flight string prep, telemetry analysis, mapping
- Radio direction finding
- Track and recovery team
- Public relations
- Real time balloon location sent to FAA via Internet



# Educational Partners

## ■ Primary schools:

- Thunder Ridge, Aurora
- Longs Peak
- Cheyenne
- Pueblo

## ■ High schools:

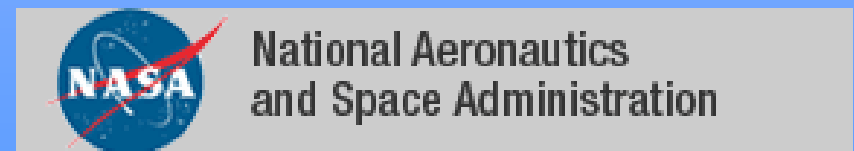
- Cherry Creek, Ranum, Green Mountain, Air Academy

## ■ Universities:

- NASA Space Grant Consortium
- CU Boulder & Colorado Springs
- U. of Southern Colorado
- Colorado State University
- U.S. Air Force Academy
- Montana State, U.of Wyoming, U.of Kentucky

# Additional Partners

- Boy Scouts of America (JOTA)
- Colorado State Fair
- Denver Museum of Natural History
- American Institute of Aeronautics and Astronautics (AIAA)
- Pioneer Astronautics (Mars)
- Air Force Research Labs
- National Oceanic and Atmospheric Administration (NOAA)
- National Aeronautics and Space Administration (NASA)



# Typical Student Payloads

- Prototype satellite testing
- High altitude photography
- Solar UV imaging
- Spin stabilization
- Comparative barometric pressure sensing
- Ozone and hydrocarbon profiling
- Silicone solar cell efficiency vs. altitude
- Gravimetry vs. altitude
- Ionizing radiation profiling
- Environmental tolerance of cockroaches



# EOSS Highlights

- **First Flight, EOSS-1 (WVN-1), Nov 18, 1990**
- **First school flight was EOSS-4, Jan 4, 1992, carrying CU's "Humble Telescope"**
- **EOSS-100, Nov 12, 2005, Intrado, Longmont**
- **Have launched from Laramie to Pueblo**
- **100% Payload Recovery Record – 106 flights**

# NOAA Air Core

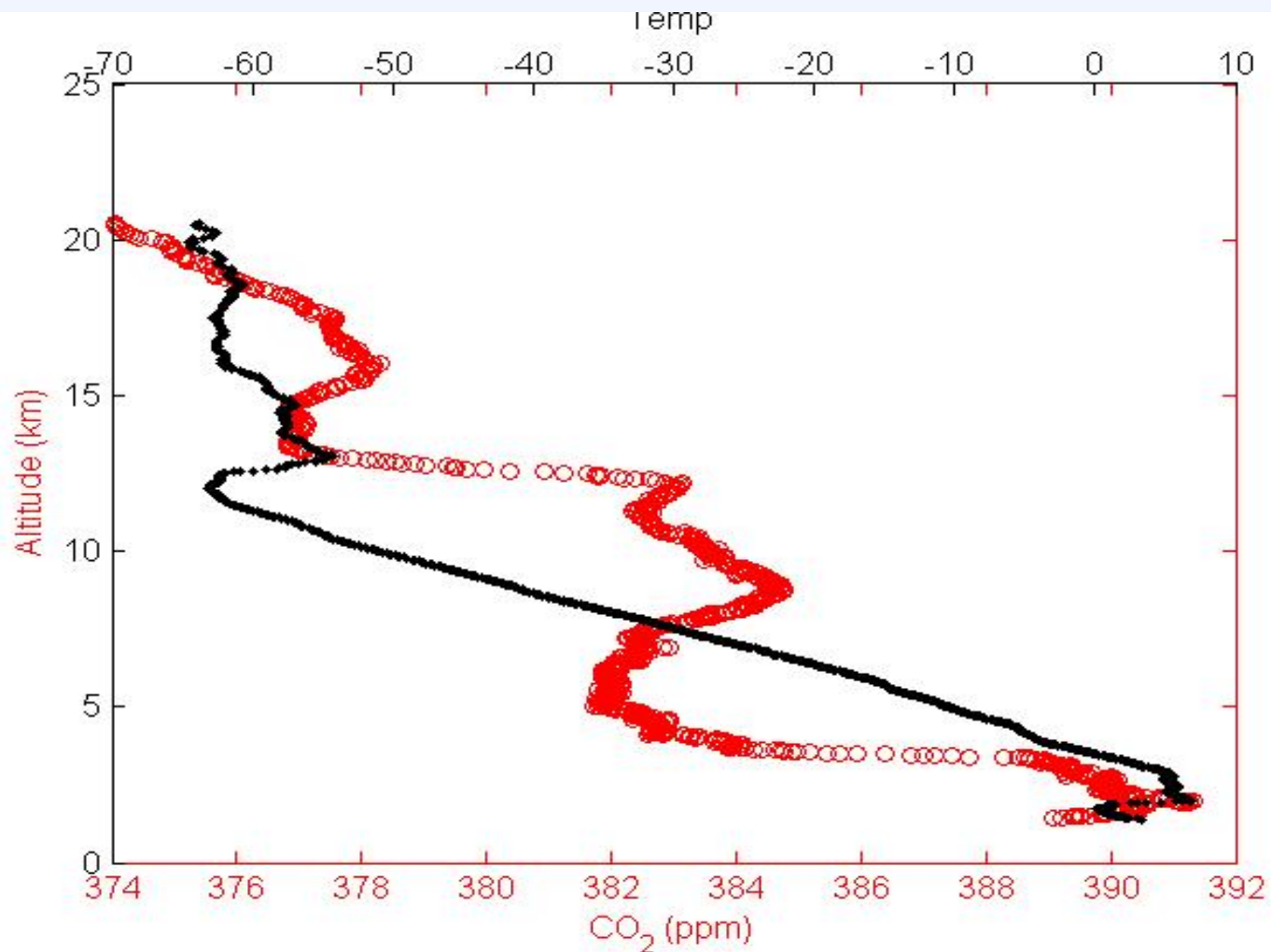
- Obtains sample of the air during descent
- Sample is similar to a “core sample”
- Analyzed to measure carbon dioxide levels



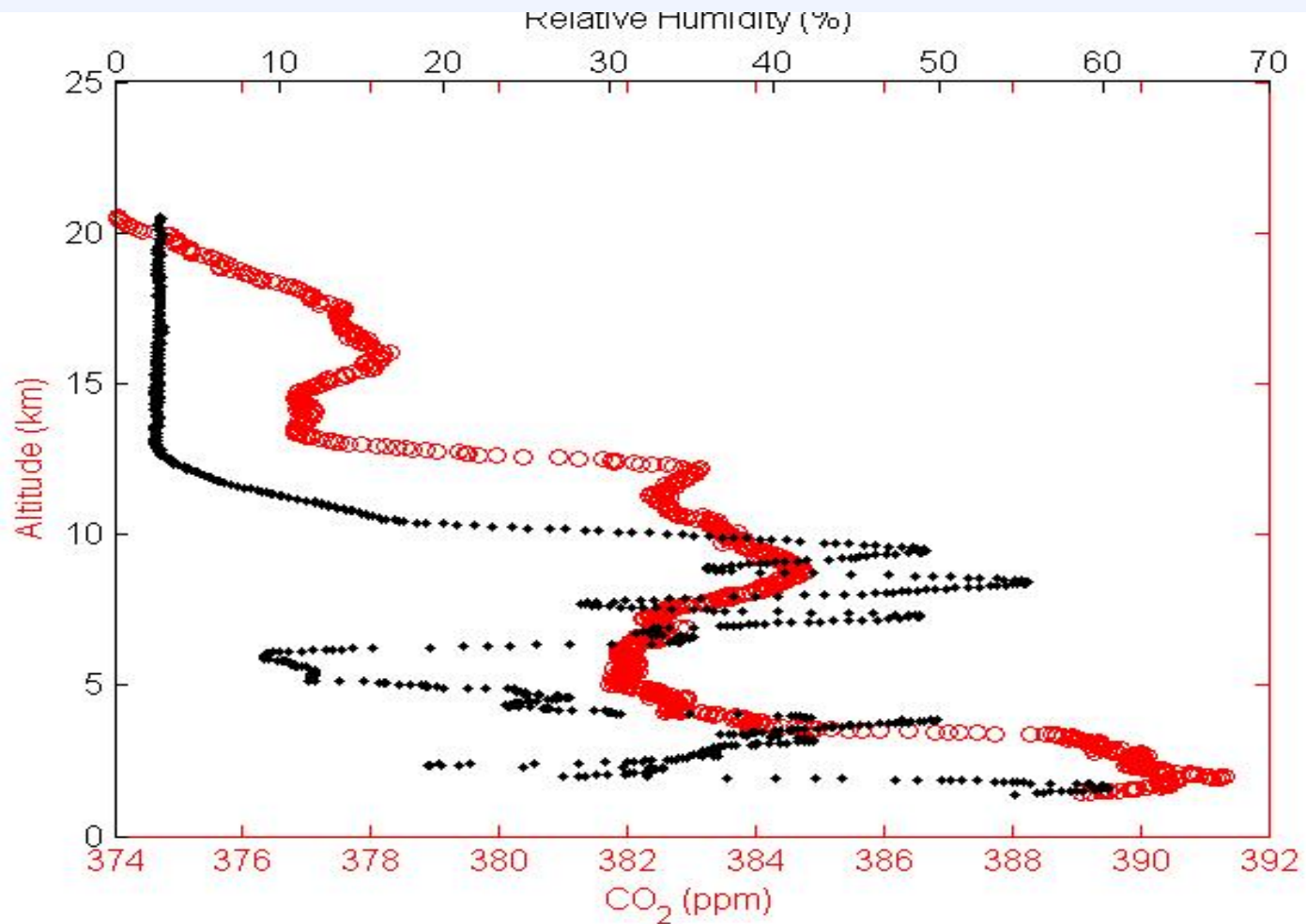
# NOAA Air Core



# NOAA Air Core



# NOAA Air Core



## Develop a high altitude inflatable-winged aircraft

- Can fly in the thin air at 100,000 ft altitude, as on Mars
- Can be packaged compactly for transportation to Mars
- Can be inflated to full size when deployed on Mars
- Can be rigidized by solar ultraviolet radiation to permit flight

Deploy and fly it ...



# UK BIG BLUE

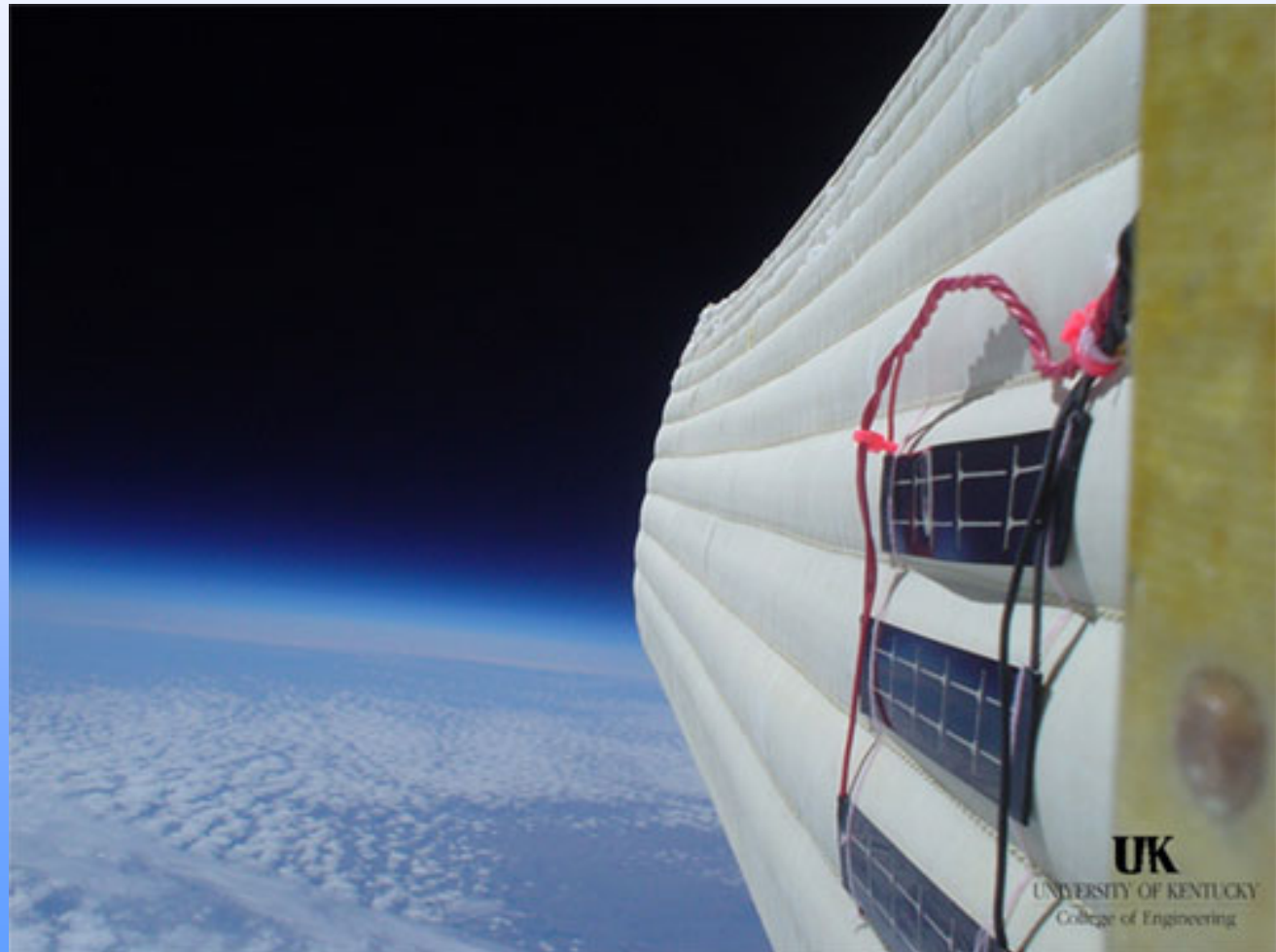
■ **B**aseline  
**I**nflatable  
**G**lider  
  
**B**alloon  
**L**aunched  
**U**nmanned  
**E**xperiment

Complete NASA-Like Mission:  
**Student teams, design, build, test, launch, deploy, fly, analyze, and report on a high-altitude glider as a prototype Mars UAV explorer.**

(The “UK color” is blue, and “Big Blue” is the nickname for UK athletic teams)

# UK BIG BLUE

- *The Wing!*
- *At 96K Feet*



# UK BIG BLUE

- Big Blue I EOSS-66 May 3, 2003
- Big Blue II EOSS-76 May 1, 2004
- Big Blue III EOSS-90 April 30, 2005
- Big Blue IV (tentative)





# Learn More about EOSS

## ■ See our Web Site at [www.eoss.org](http://www.eoss.org)

- Upcoming flight announcements, launch site directions
- Past flight summaries with photographs
- Download the EOSS Handbook
- Links to other balloon groups

## ■ Join EOSS weekly net:

- Tuesdays at 8:00pm on CRA 147.225/link

## ■ Monthly Meetings

- Second Tuesday of the month at 7:00pm
- Ft. Logan Health Center



# Attend a Launch

## ■ Attend our next launch:

- EOSS-107, -108 for CU Gateway and Demosat program
- Saturday July 15 2006
- First launch 07:30am
- Second launch 08:15am
- Deer Trail High School
- Directions and current information posted on [www.eoss.org](http://www.eoss.org)



# Typical Flight Profile

- Obtain Certificate of Waiver from FAA (yearly)
- Launch date (Sat / Sun backup) set two months in advance
- Payload planning and launch site selection starts one month before flight
- Launch, ground station and tracking/recovery team commitments - two weeks before flight
- HIBAL Notice filed with FAA - one week before flight
- NOTAM (notice to airmen) – two days before flight
- Preflight net on CRA & go/no-go decision 8:00pm - evening before flight

# Flight Day-Launch Team

- **Flight day schedule: Launch team**
  - Launch site setup and flight string prep @ 06:00a
  - Forecast trajectory to FAA @ 07:00a



# Flight Day-Launch Team

- Latex Balloon fill w/ Helium @ 07:15 a.m.



# Flight Day-Launch Team

## ■ Launch & ascent

- Launch @ 07:30 a.m.
- Ascent rate  
~ 1000 fpm (or more)
- 11 Student  
payloads



# Flight Day-Launch Team

- Real time FAA position reports via Internet
- Burst/cut down between 90-100 K ft, 20 - 50 miles downrange



# Flight Day-Tracking Team

- Typical flight sequence
- Early morning breakfast-somewhere
- Monitor launch site progress



# Flight Day-Tracking Team

- Deploy trackers around the predicted touchdown location



# Flight Day-Tracking Team

- Monitor launch and flight path with Grid Calc



# Flight Day-Tracking Team

- **Locate land owners and obtain permission to enter property**



# Flight Day-Tracking Team

- Secure payloads and wait for students to arrive



# Flight Day-Tracking Team

■ ...And the students arrive!



# Flight Day-Lunch

- Finished! Time to find a place to EAT LUNCH



- 10 minutes total
- Shows several launches
- Shows some high wind conditions
- ..... 'taint as easy as it looks!!!