

# **Twenty Years of Amateur Radio High Altitude Ballooning in Colorado**

**Dayton Hamvention  
Dayton, Ohio**

**May 14, 2010**

**Nick Hanks, NØLP**

## What's 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 with Firsthand Experience with Science and Technology to the Edge of Space**
  - **Provide Low-cost Access to the Edge of Space for Scientific and Engineering Organizations**
- **Funded by Donations, Fees and 60+ memberships**
- **An ARRL-affiliated club**



- Before There Was EOSS, There Was Western Vision Network (WVN)
  - Denver, CO-based Amateur Television (ATV) Group
- They Just Wanted To Fly ATV setup and See Some Pictures
- First Flight on 18 Nov 1990 from County Park in SW Denver Area
- That Flight Hooked Some ATV Members Who Would Become Core of EOSS
- WVN as a Group Didn't Really Want To Tie Itself Down to an Ongoing Balloon Launch Schedule, so Core Members Created New Group – Edge of Space Sciences



Seems To Have Worked Out OK



- Nov '90 – First Flight. 10 m Beacon, ATV, Pressure Sensor (~96,000 ft./132 mi.), DF Tracking
- Mar '91 – Beacon on 147.555. DF'ing Takes a Big Step Forward
- Sep '91 – 40 m In-flight Net Established
- Jan '92 – First Flight for Educational Institution & FAA Coordination Starts
- Apr '92 – First Attempt To Attempt To Track Balloon using Onboard VOR Receiver
- Jul '92 – First Time Crossband Repeater Used (70 cm up/2 m down)
- Feb '93 – First Time Tracking Balloon using Onboard LORAN-C Receiver
- May '93 – First Time Tracking Balloon using GPS Receiver
- Aug '93 – First Great Earth/Space Picture Taken
- May '94 – First Time Tracking using APRS
- '95 – Web Site Established
- '02 – General Use of Balloon APRS Digipeater
- Feb '03 – First Flight of Despun ATV
- Feb '03 – Use of I-Gater Data To Provide FAA Balloon Position Webpage
- Jun '04 – First Flight of Rechargeable Li-Ion Batteries
- Nov '05 – 100<sup>th</sup> Flight
- Feb '06 – First Flight of Fast Release
- Feb '09 – First Flight of 3-view Digital Camera (Intervalometer)
- Mar '07 – First Flight of ZigBee GPS ATV Support Module



- **Balloon-borne Radios:**
  - **GPS-based Time, Location, Altitude and Speed (APRS) Reporting**
  - **Live Television (ATV)**
  - **Cross Band Repeater (400+ mile Radio Horizon)**
  - **Flight and Experiment Telemetry**
  - **Cut-Down Commanding**
  - **Radio Direction Finding (RDF) Beacon**
- **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**



# Notables



**“Bill Brown, WB8ELK, was very helpful on this flight. He loaned us a TV camera, a 10 meter beacon, sent us copies of his program BALLTRAK and answered any questions we could dream up.” Report on EOSS-1 in WVN Newsletter**

# Jack Crabtree, K7JLC (AAØP)







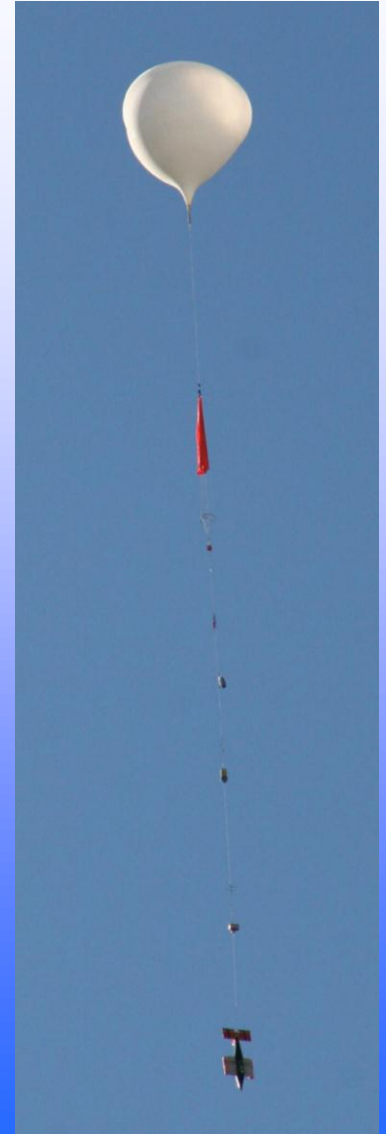
# Our Web Site (www.eoss.org)

- About 8,300 Pages of Data
- Around 6,000 Hits/Month
- 75% of Visits Were Referred, e.g., from Google
- Has Software Library, including Rick's Modified BalloonTrack, for Prediction/Tracking
- Single Source for All Pre- and Post-flight Info

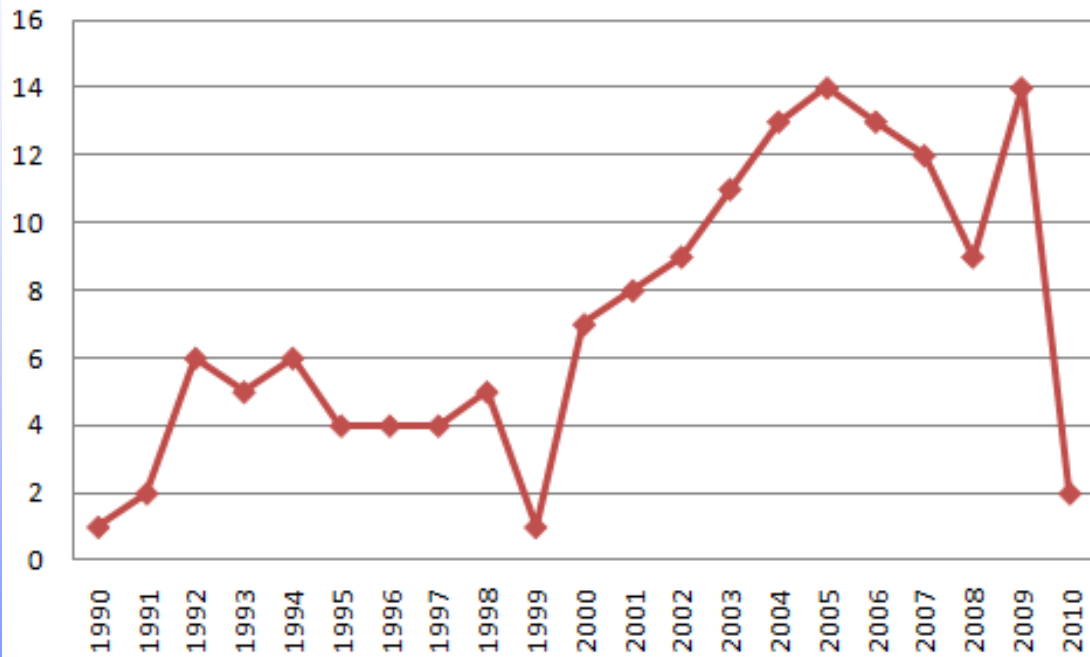


Webmaster – Rick,  
NØKKZ

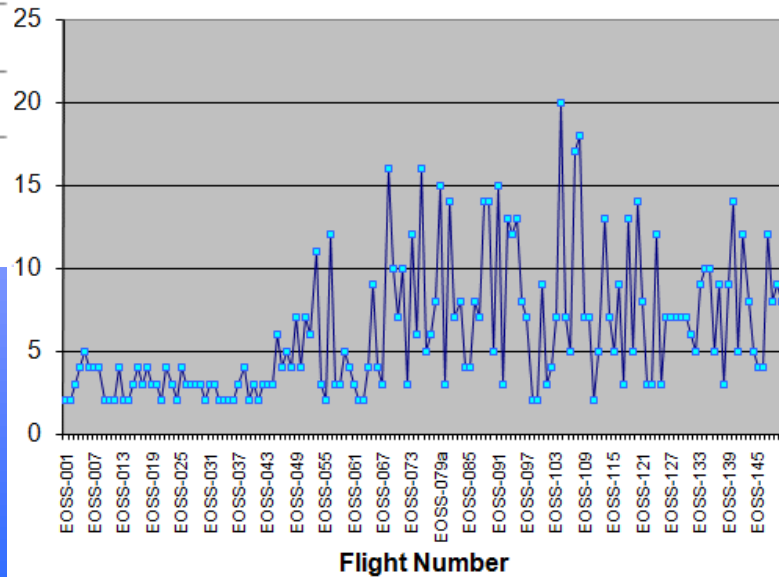
# Facts and Stuff



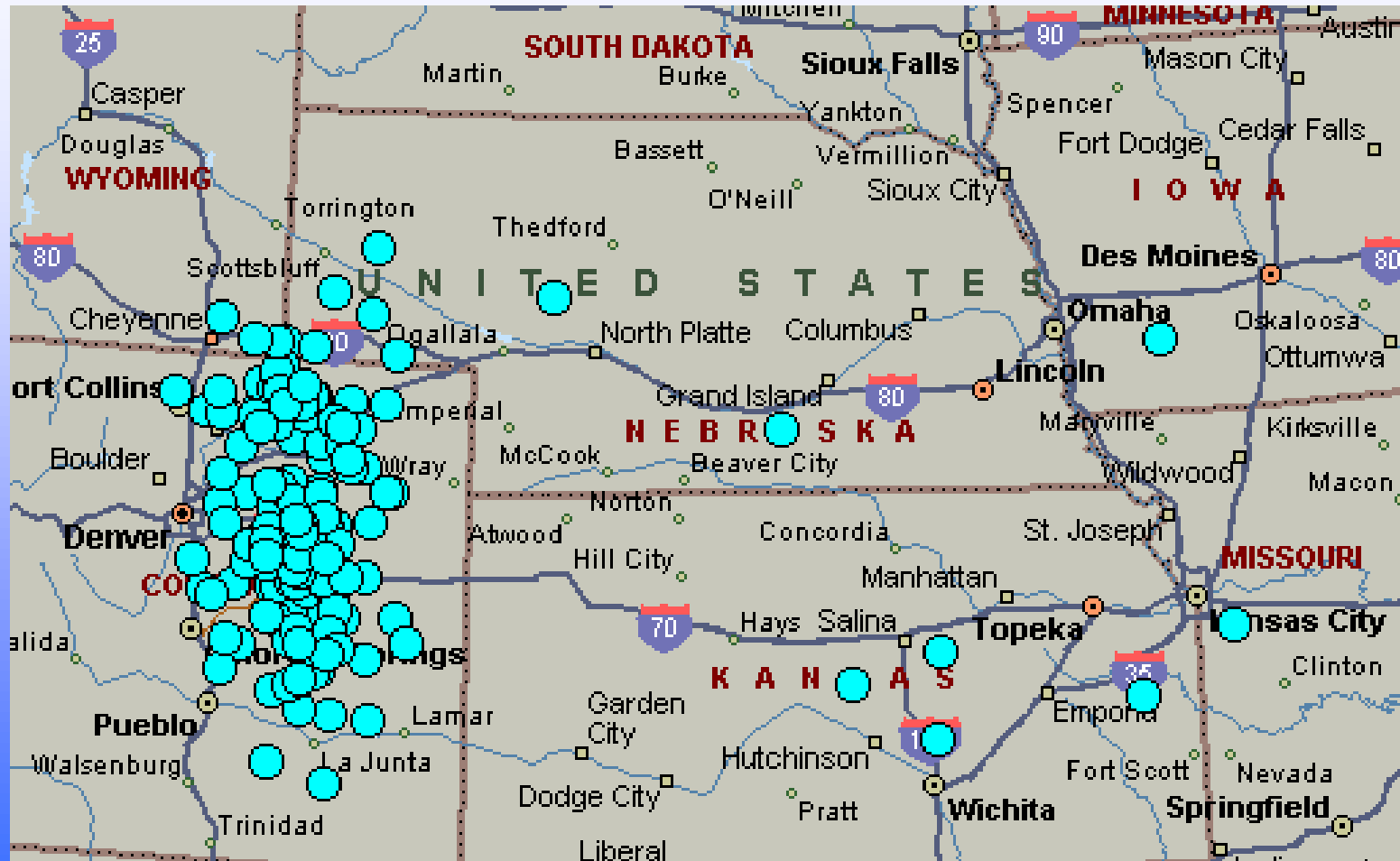
## Flights Per Year



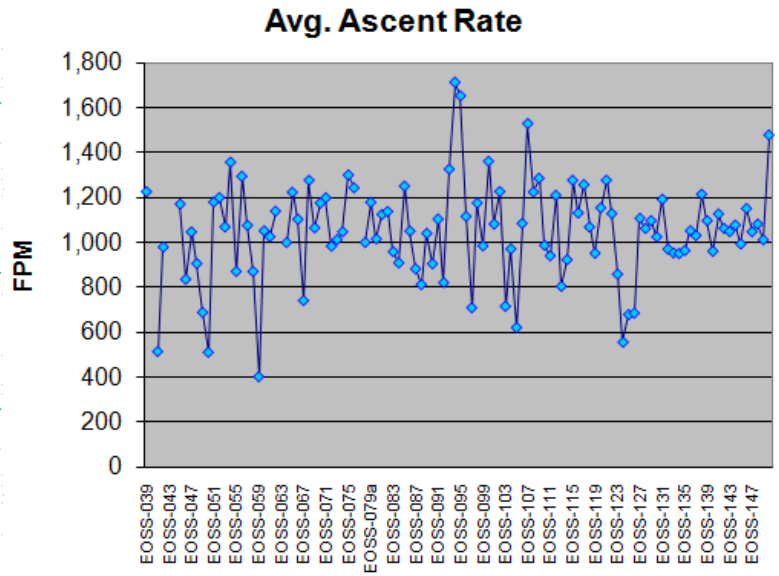
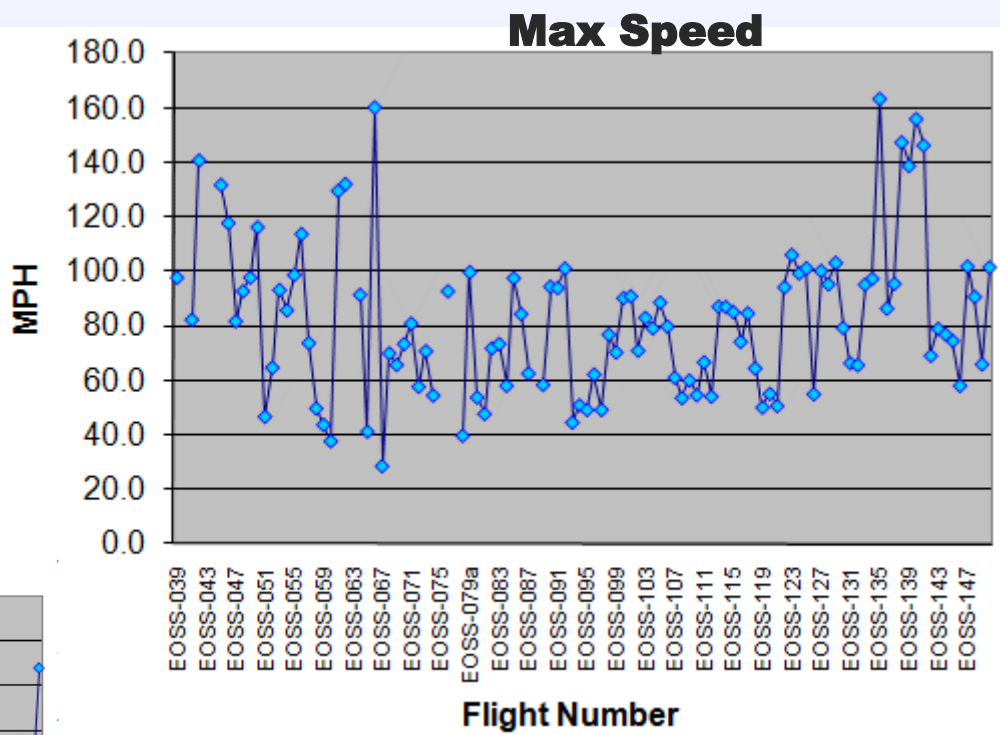
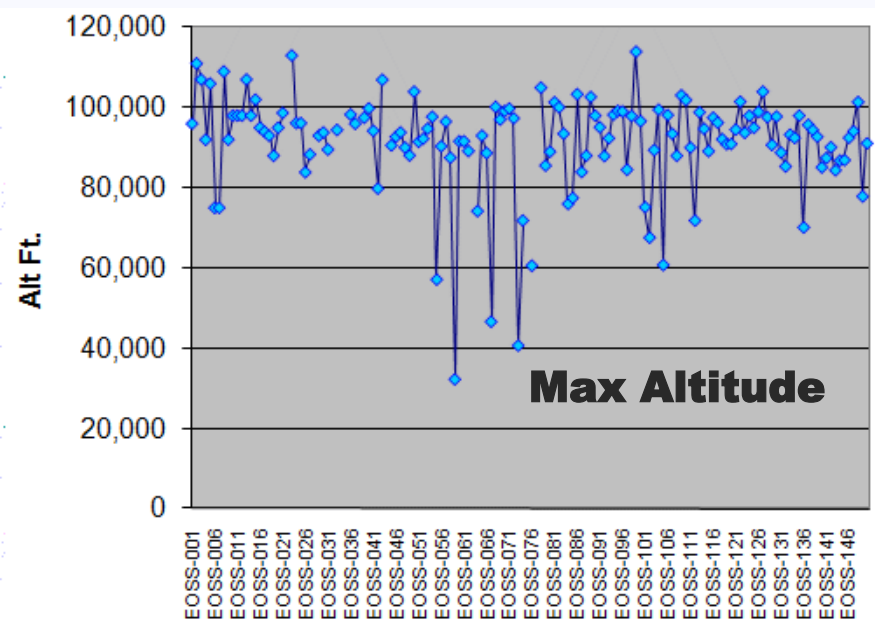
## Total Number of Payloads per Flight



# Where We've Landed



# Some Flight Parameters



- **Primary Schools:**
  - Thunder Ridge, Aurora
  - Longs Peak
  - Cheyenne
  - Pueblo
- **High Schools:**
  - Cherry Creek, Ranum, Green Mountain, Air Academy
- **Universities and Colleges**
  - NASA Space Grant Consortium
  - Univ. of Colorado Boulder & Colorado Springs
  - Univ. of Southern Colorado
  - Colorado State University
  - U.S. Air Force Academy
  - Montana State
  - University of Wyoming
  - University of Kentucky



## Some More Familiar 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)**



**National Aeronautics  
and Space Administration**

# Some Types of Student Payloads

- **Prototype Satellite Subsystem 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**
- **Rovers – Lots and Lots of Rovers**
- **Horizon Brightness Measurements**
- **High Altitude Micro Organism Detection and Identification**
- **Environmental Tolerance Of Cockroaches**



## Notable Flight Campaigns



- **Gateway: Freshman Program Designed for Project Skill Development**
- **Space Grant: NASA-sponsored Program involving Twelve Colleges and Universities In Colorado**
- **Providing Students the Opportunity To Put Theory Learned in the Classroom To Use On Hands-on Space Hardware and Satellite Programs**
- **Balloonsat Missions Provide Students with Little or No Hardware Experience the Opportunity To Develop, Build, Test, and Fly Small Payload that Can Reach 100,000 ft.**

**Over 60 Flights!**



Chris Kohler

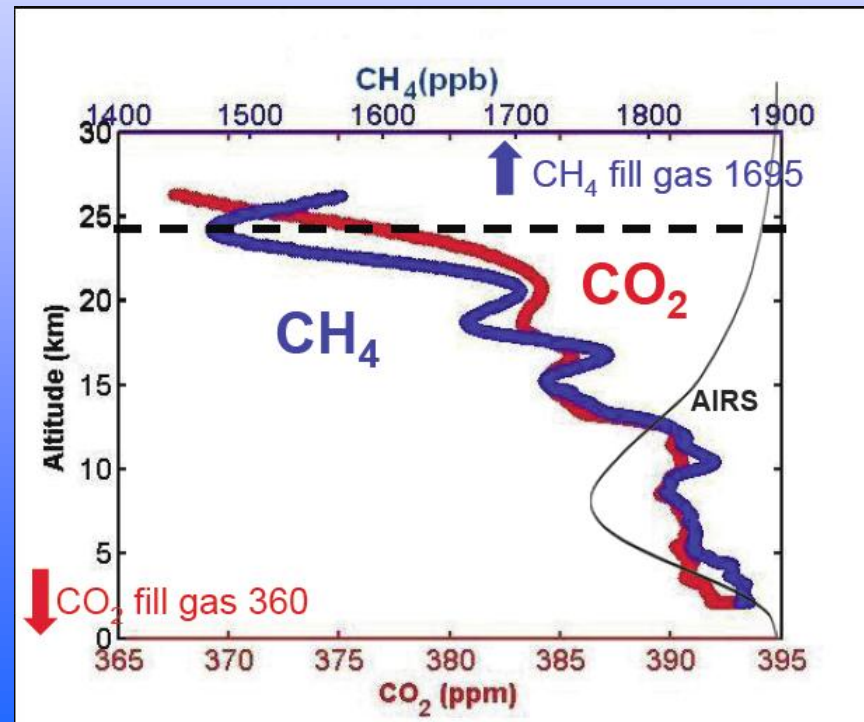


- Develop High Altitude Inflatable-winged Aircraft That
  - Can Fly in Thin Air at 100,000 Ft Altitude, as on Mars,
  - Can Be Packaged Compactly For Transportation To Mars,
  - Can Be Inflated To Full Size When Deployed on Mars, and
  - Can Be Rigidized by Solar Ultraviolet Radiation To Permit Flight or by Gas Pressure
- Deploy and Fly It ...

- Big Blue I -- EOSS-66 May 2003
- Big Blue I -- EOSS-76 May 2004
- Big Blue III -- EOSS-90 April 2005
- Big Blue V -- EOSS-115 March 2007



- Obtains Sample of Air during Descent
- Sample Is Similar To a “Core Sample”
- Analyzed To Measure Carbon Dioxide & Methane Levels
- Very Accurate and Repeatable
- Becoming the Standard for High Altitude Sampling
- EOSS Has Flown Three Flights Carrying AirCore Sampler



# Operations

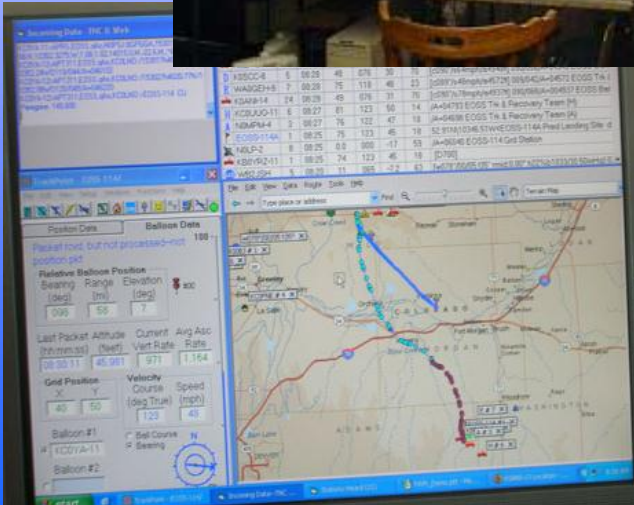




# Some More Launch



# The Ground Station





# Landing Sites



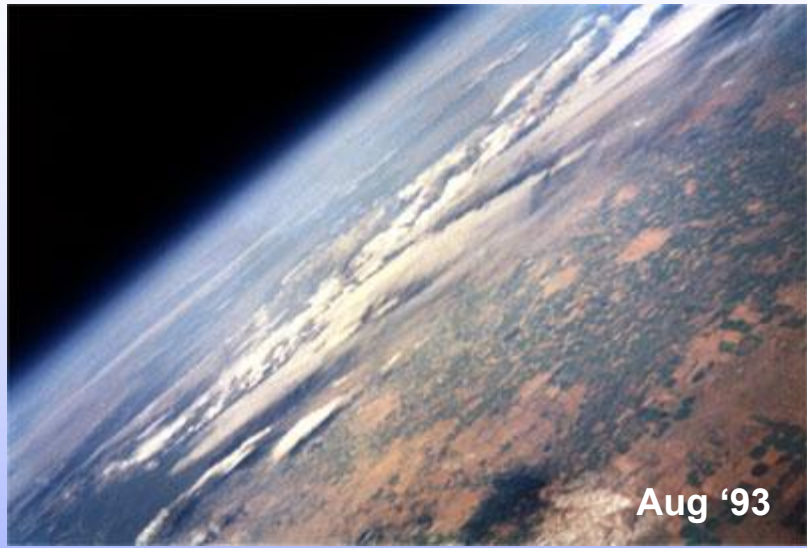
# Some More Landing Sites



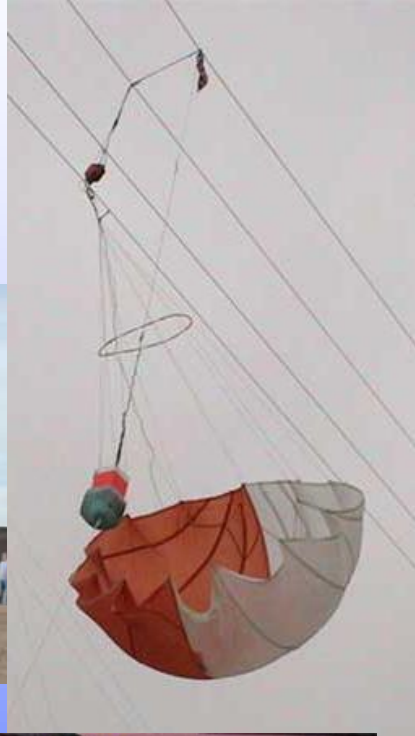
# And Some More Landing Sites



# Yea, We've Taken Some of those Pics Too



# It Stays Interesting



**Launched 150**  
**Recovered 150**









**Thank You and 73**

[www.eoss.org](http://www.eoss.org)

[www.eoss.tv](http://www.eoss.tv)