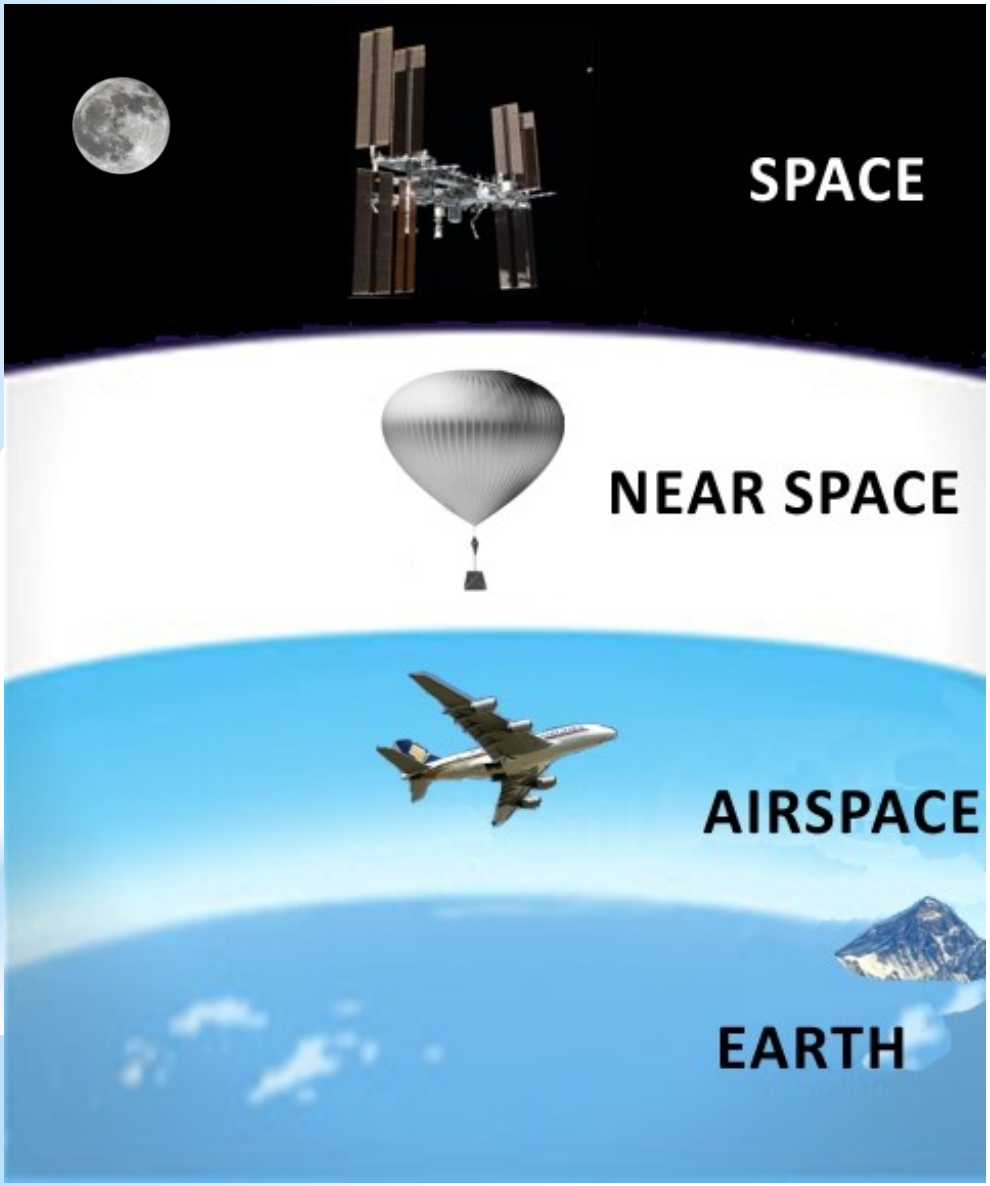
Near Space

38 km Above Carman Manitoba

Manitoba Association of Physics Teachers

Rob Striemer (VE4SHS)

Where is Near Space?

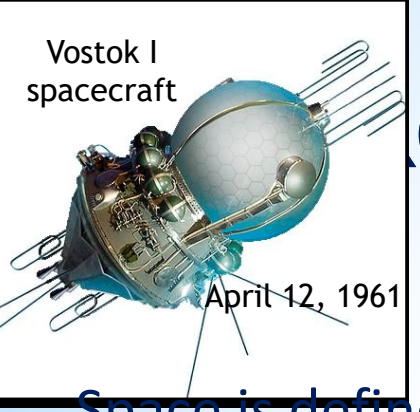


100 km (328,000 feet)

20 km (65,000 feet)

8.8 km – Mt. Everest

sea level



eaching Near Space


A School HAB
126,000 ft/38.5 km
October 28, 2011

Space is defined by the International Aeronautical Federation as being above 100 kilometres.

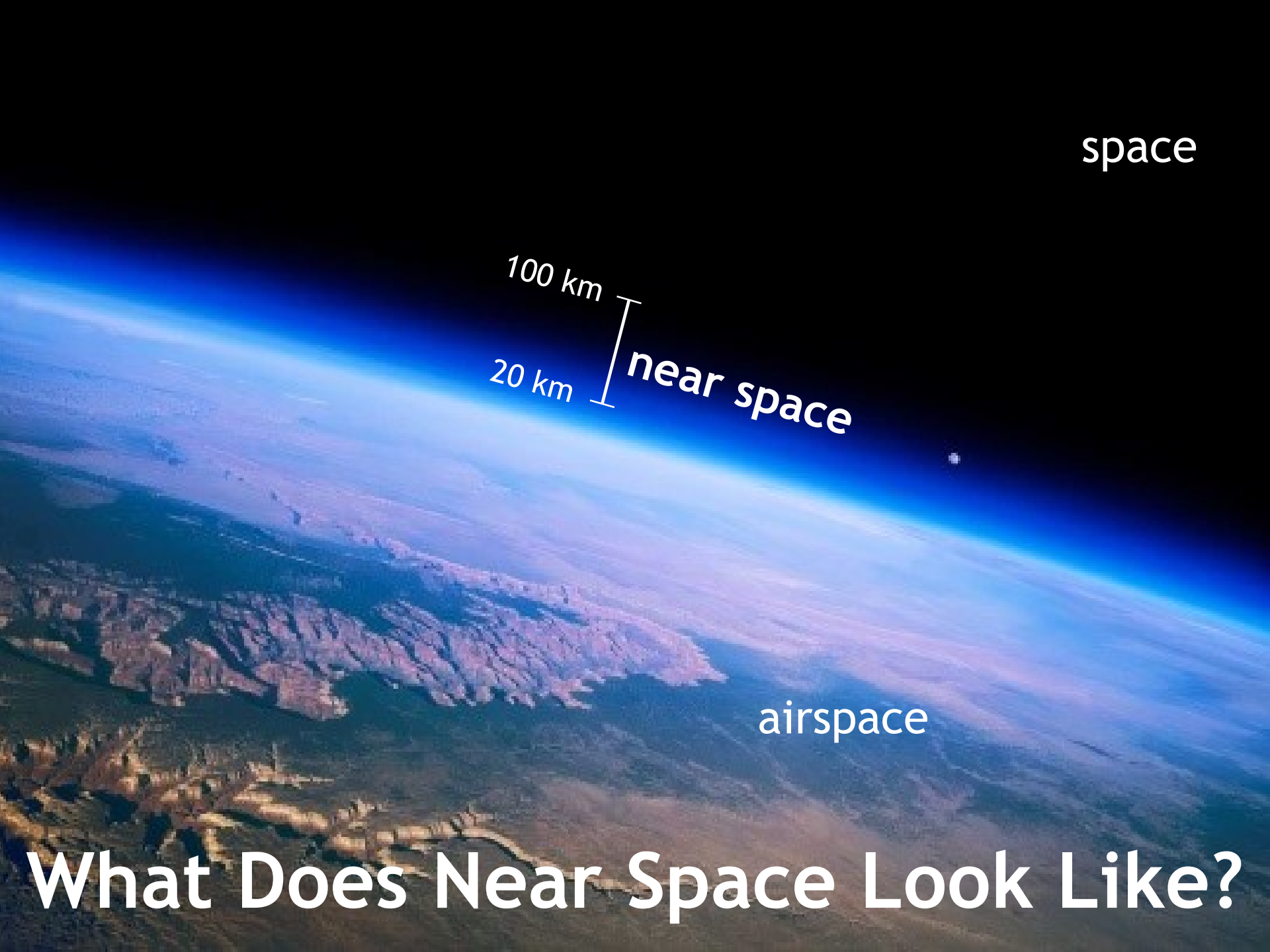
Near space comprises the altitudes above where commercial jets fly but below orbiting satellites. It's the region of Earth's atmosphere that lies between 20 and 100 km (65,000 and 328,000 feet). Near space includes the stratosphere, mesosphere, and the lower thermosphere.

Specialized military aircraft such as the famous U-2 spy plane reached the lowest levels of near space. Rockets briefly pass through near space. The only craft that regularly visit near space are **high altitude balloons** or **HABs**.


U2 Spy Plane
70,000 feet
May 1, 1960


SR-71
85,000 feet
1966-99

Boeing 767
35,000 feet
2017



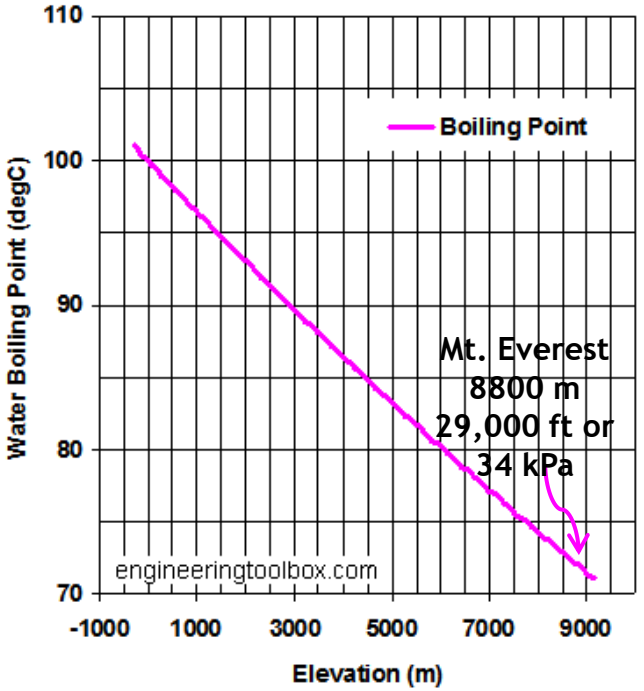
What Does Near Space Look Like?

What is Near Space Like?

HABs flown by Manitoba schools reach altitudes between 100,000 and 127,000 feet or 38 km.

At 65,000 feet, where near space begins, you are above the clouds and weather. The atmospheric pressure has decreased from 100 kPa to just 6 kPa. The air is completely dry but if water did exist, it would boil at body temperature (37°C). This is the Armstrong limit. A pressure suit is essential for human life.

Around 80,000 feet the sky has changed from the familiar blue to black. Stars and planets may be visible despite the harsh intensity of the sun. At 90,000 feet you can begin to detect the curvature of the Earth. Atmospheric pressure is now 1 kPA or 1% of sea level pressure. Most of southern Manitoba is visible from 127,000 feet.



HABs to
Explore and Measure
the Earth

Scientists investigate that which already is;
Engineers create that which has never been.
Albert Einstein

The words "engineer" and "ingenious" both come from the Latin root ingenerare, meaning "to create".

Science, Technology, Engineering & Mathematics - STEM

- Building a HAB involves practical problem solving, the design process and hands-on science. True aerospace engineering.
- HAB projects are challenging, fun and very exciting. Student built payloads contain experiments and cameras that hang from the HAB. Students fill their balloon with helium. They launch the balloon and track it in real time. They chase the HAB and recover their payload of experiments and cameras.
- Students learn about electrical systems, robotics, radio communications and videography, geography, atmospherics and fluid physics as well as workflow and team work.
- Flying a HAB to near space, tracking, chasing and finally recovering the payload some hours later is an adventure that needs to be experienced. The images students will get from near space are spectacular.
- Once the payload returns to the Earth the students get busy on the data analysis and scientific discovery. Presentations, symposia and science fairs may follow.

Building A Near Space Program

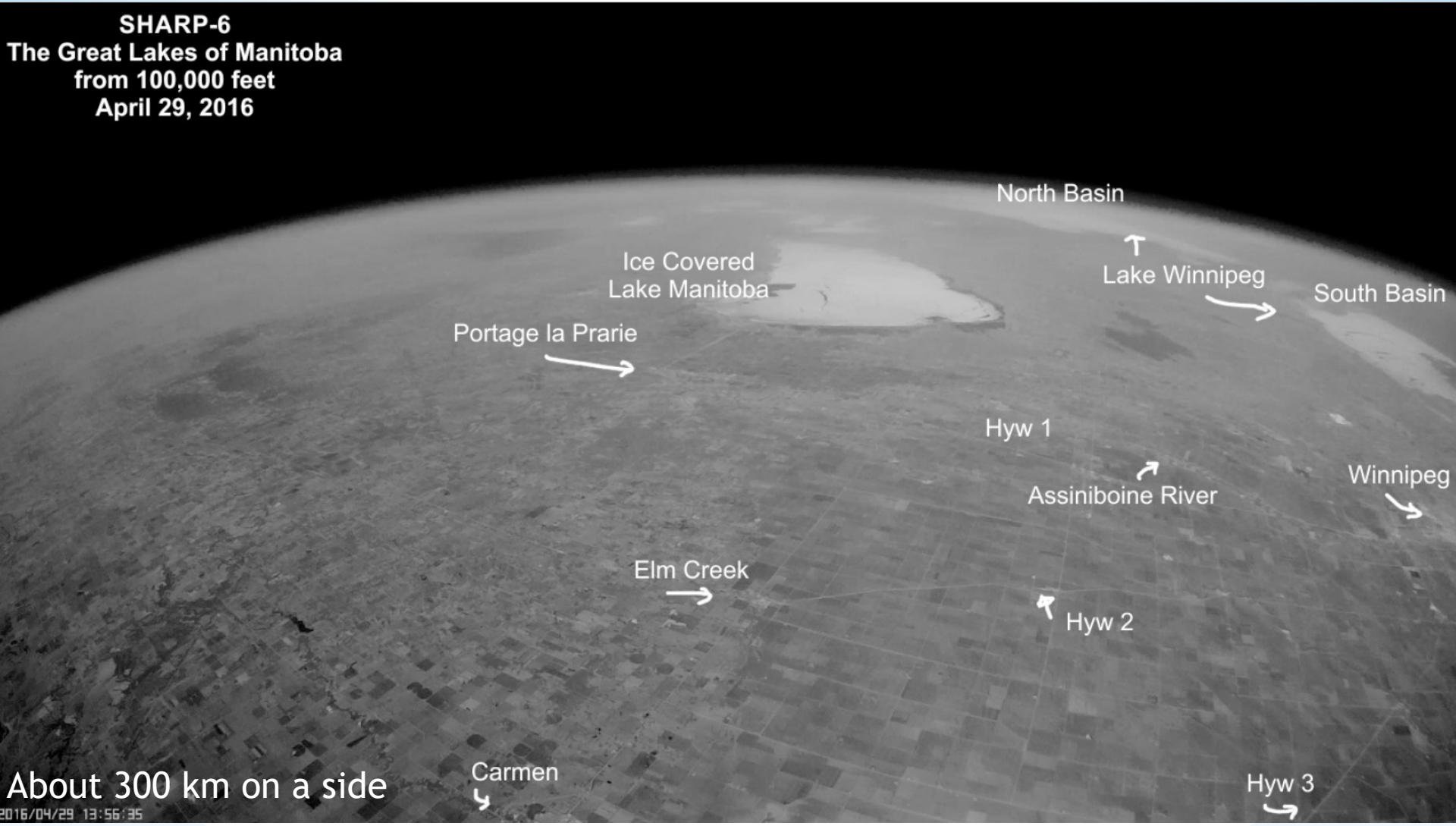


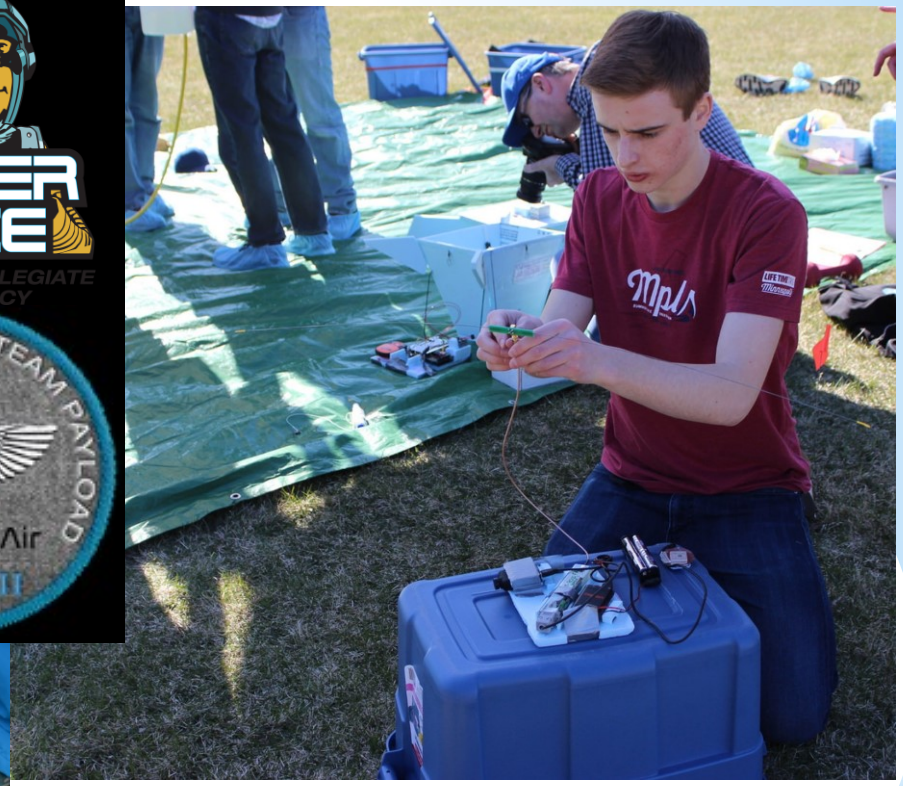
Photo of Southern Manitoba Taken from a HAB

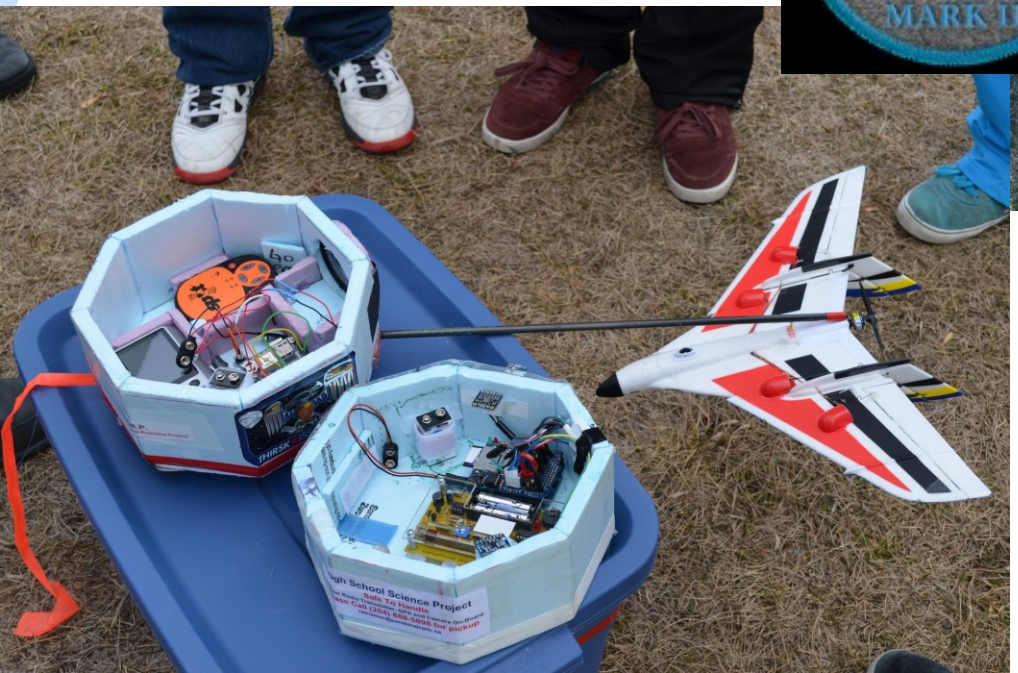
Exploring Near Space:
Research, Design, Build, Test, Launch, Track, Recover, Analyze Data, Write

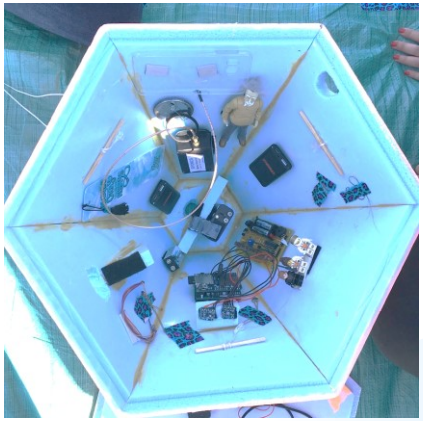
Treherne Collegiate HAB Launch Site (2013)

HAB Payloads

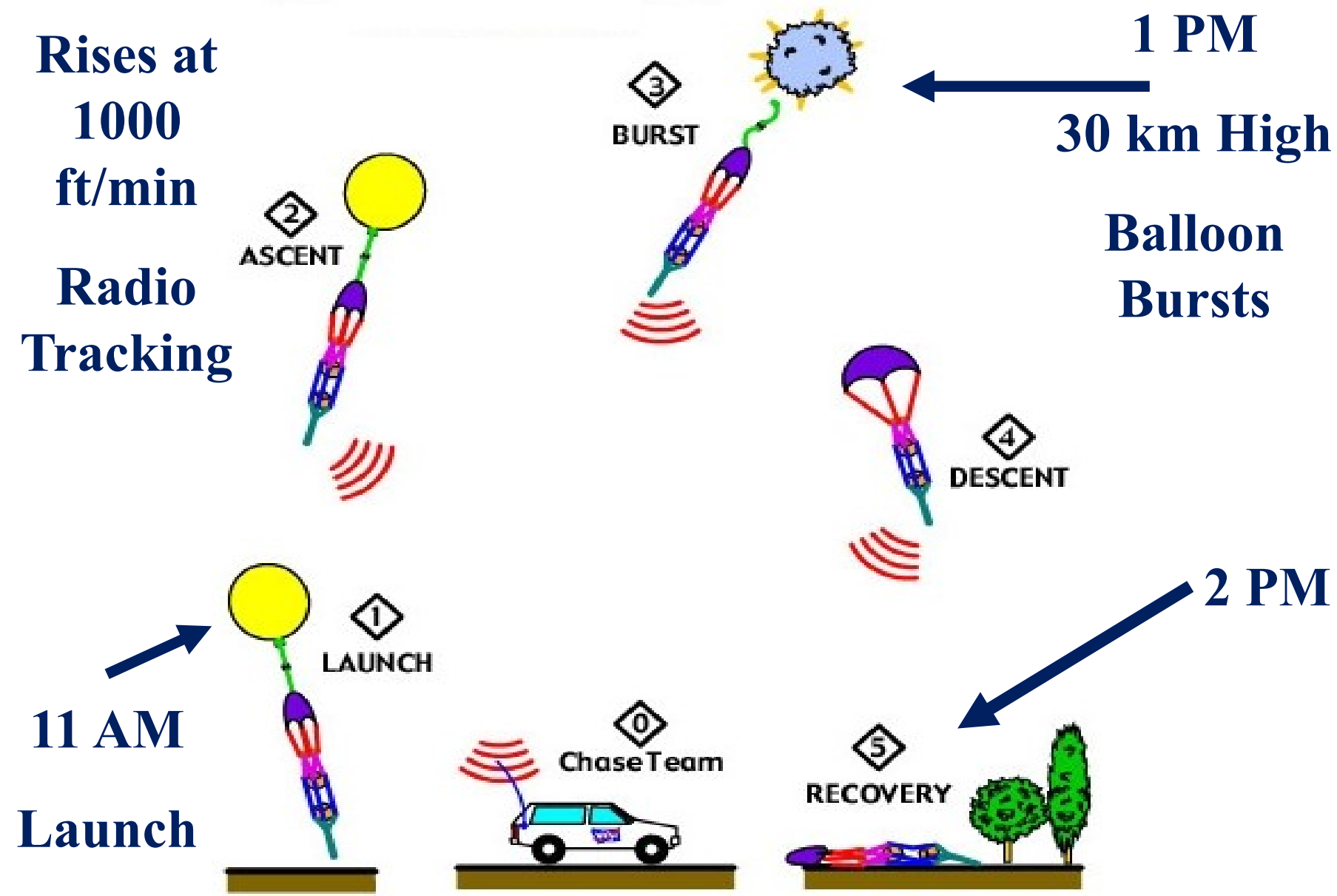
GOPHER SPACE
GARDEN CITY COLLEGIATE SPACE AGENCY
MAPLES GSBC 2016 TEAM PAYLOAD
M
Maraud Air
MARK II







Launch & Recovery Profile



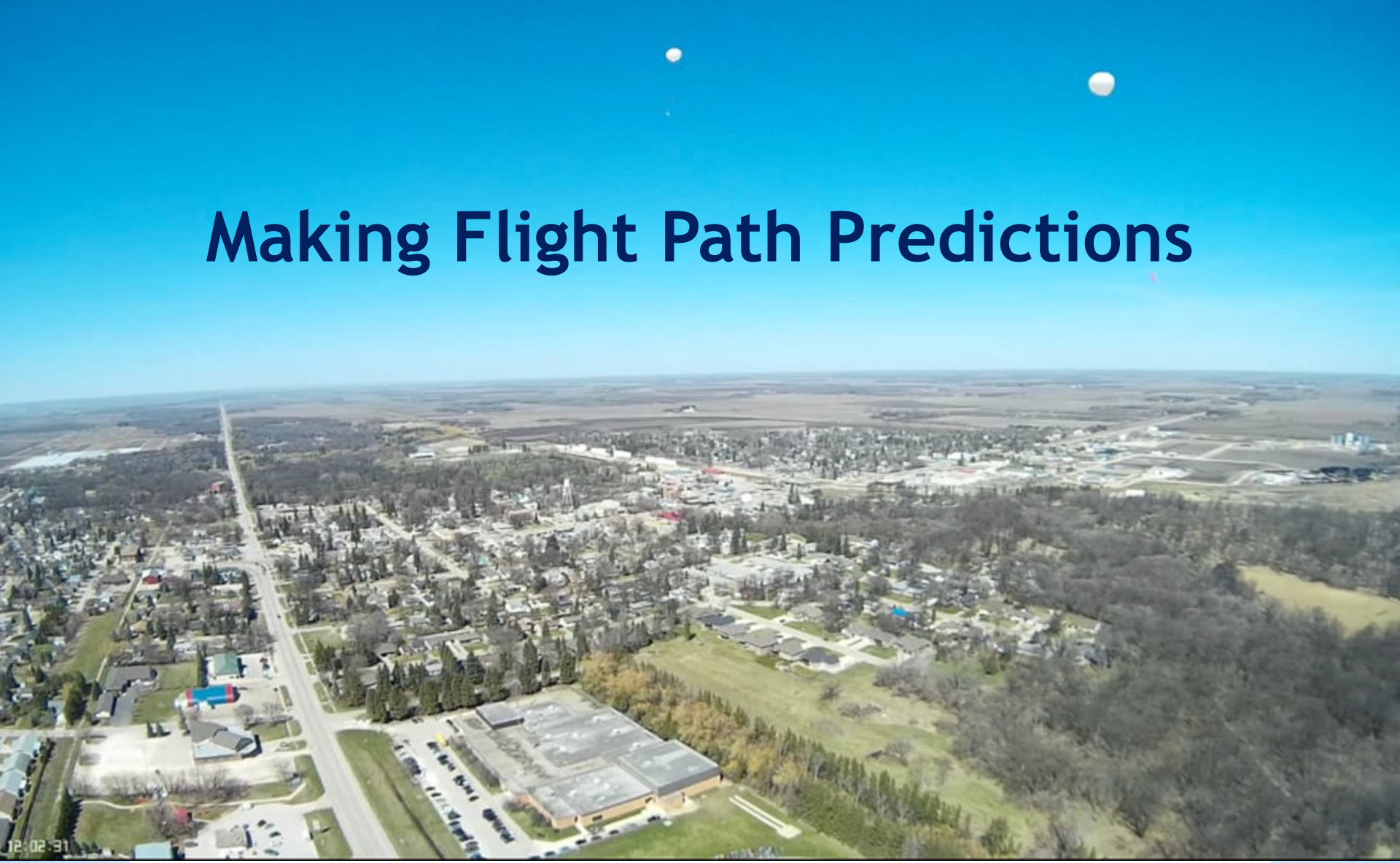
Leaving 49°30’12” N, 97°59’33” W

Using APRS and the Global Positioning System (GPS) to Track the HAB

April 30, 2016

http://shsballoonproject.pbworks.com
https://www.youtube.com/watch?v=8WhyYneVqw8
https://www.flickr.com/photos/97752407@N04/sets/72157667189233840

Making Flight Path Predictions



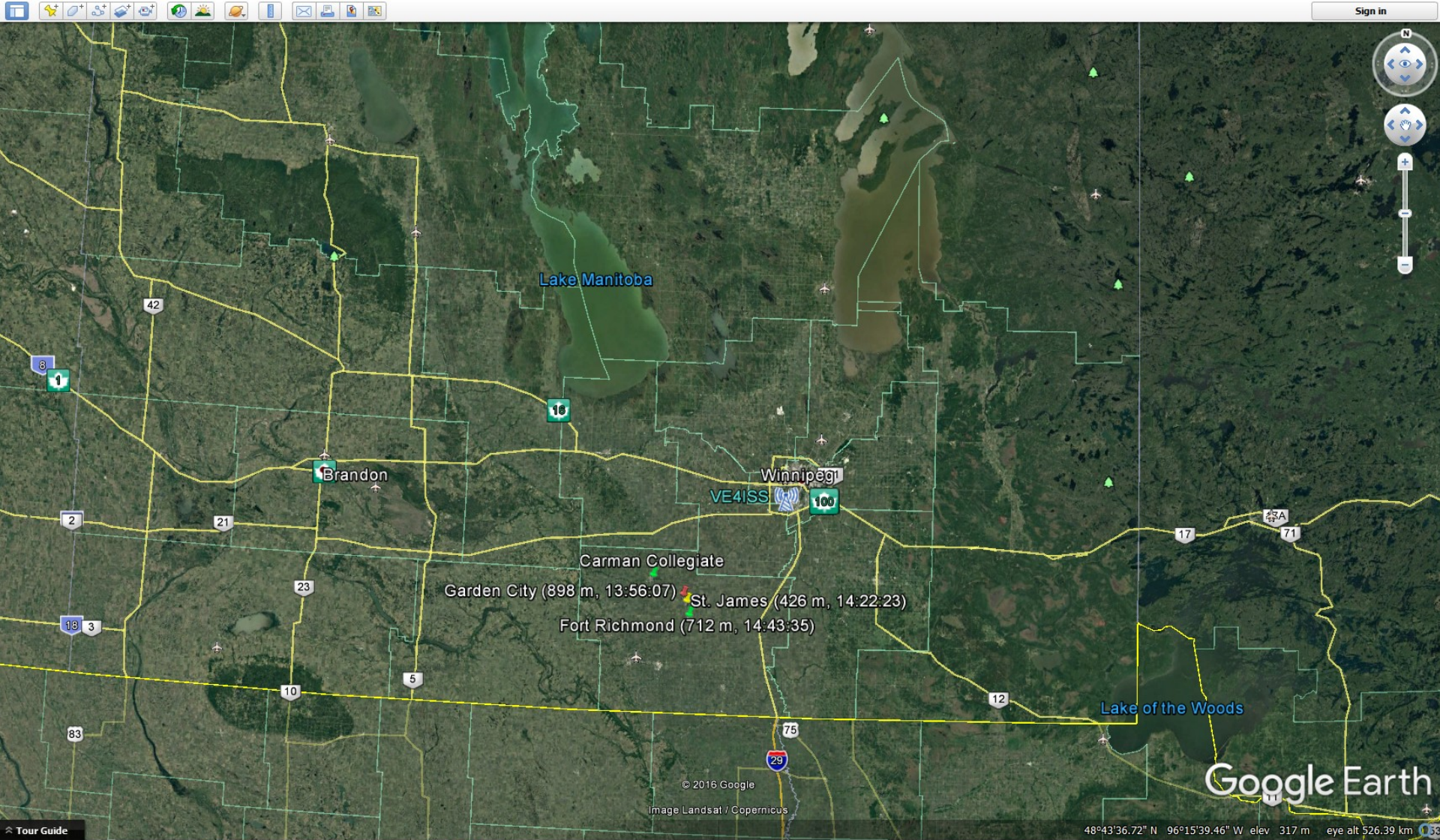
The ideal HAB launch site???

(*watch out for the powerlines along the highway*)

http://shsballoonproject.pbworks.com

http://habhub.org/

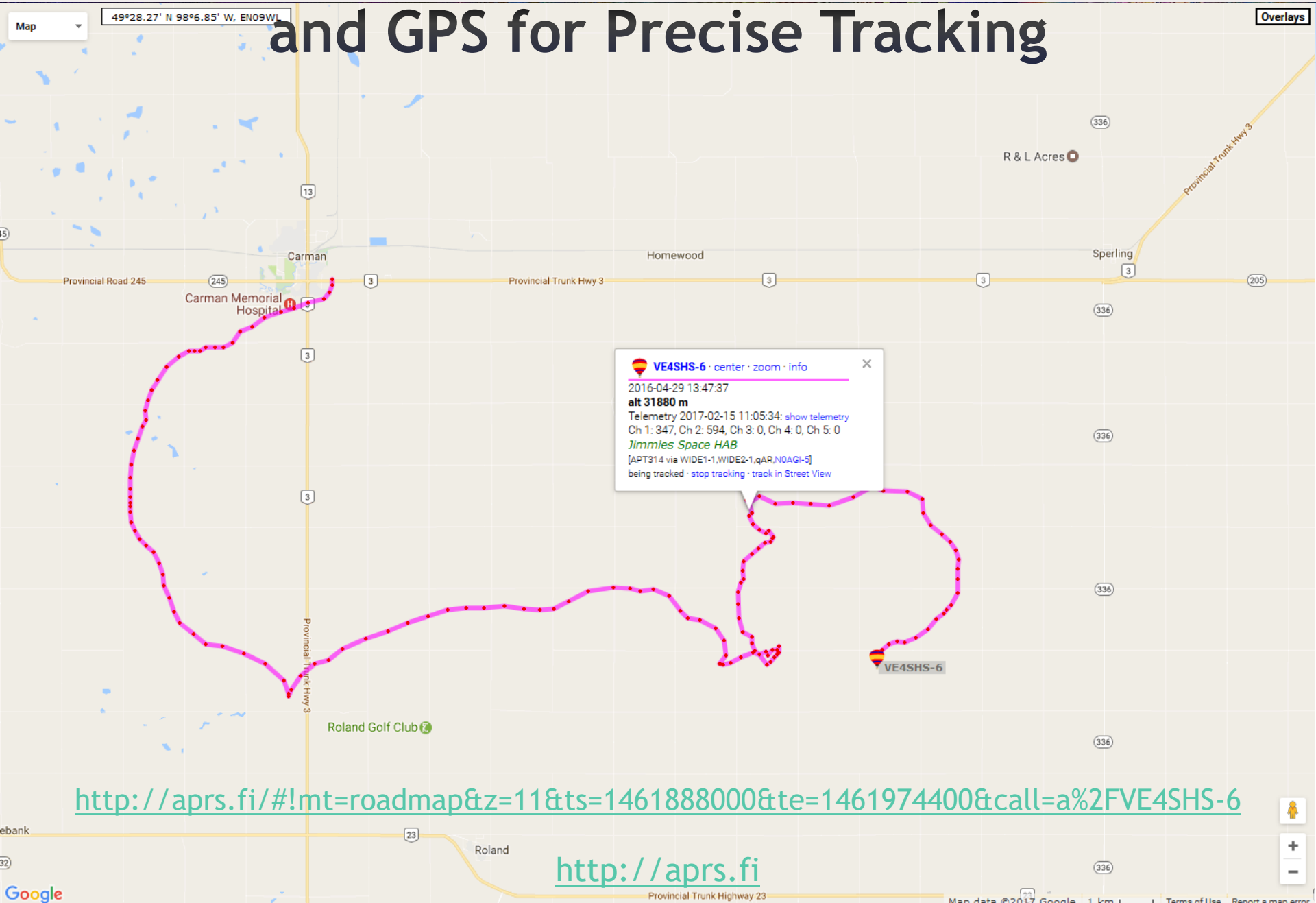
Carman is 260 m ASL. The HABs are rising at about 300 m/min or 1000 ft/min.



Where to Land?

Lakes, Bogs, Forest are Terrible
Farm Land with Section Roads are Great

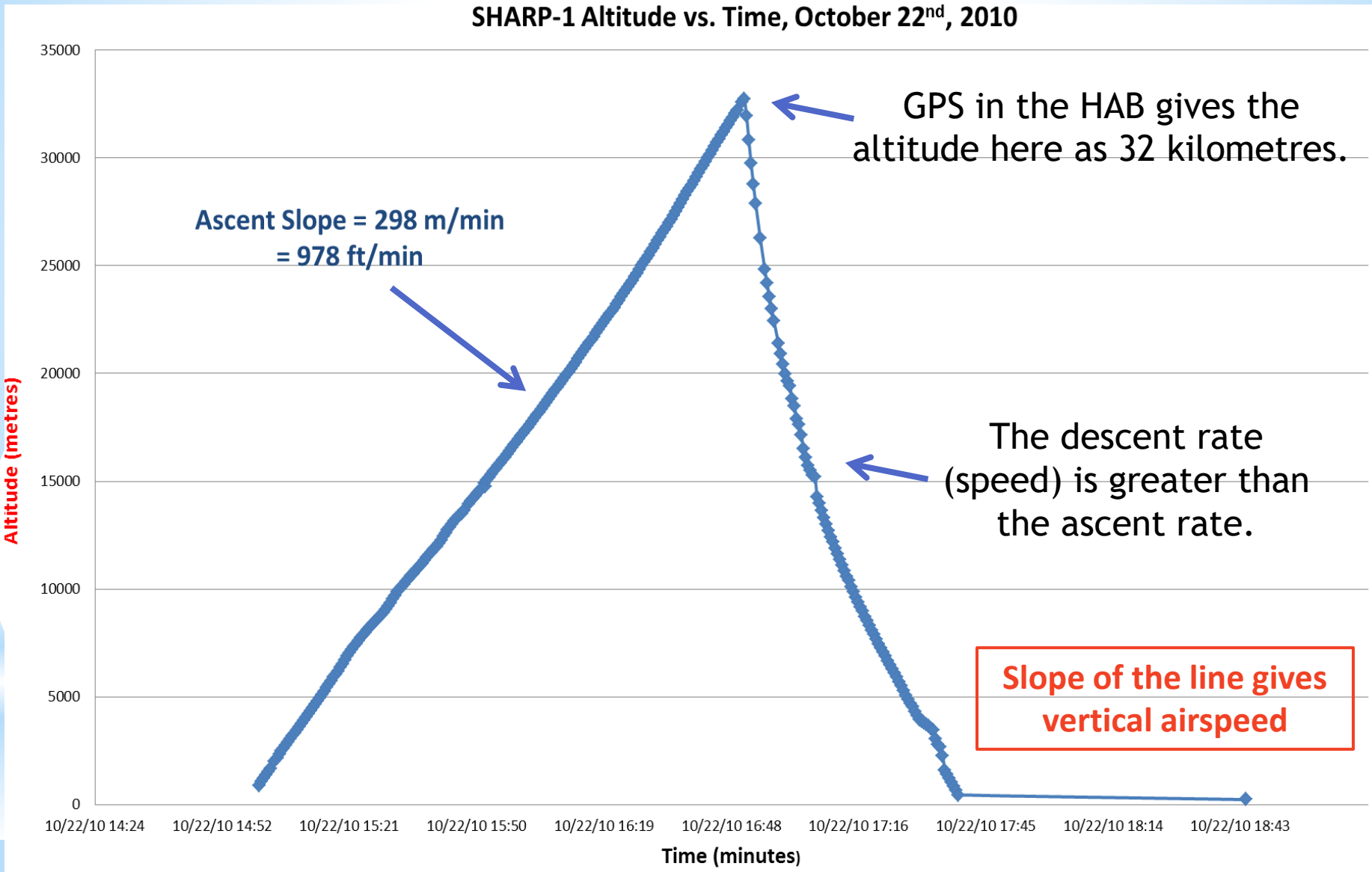
The Automatic Packet Reporting System - APRS and GPS for Precise Tracking



http://aprs.fi/#!mt=roadmap&z=11&ts=1461888000&te=1461974400&call=a%2FVE4SHS-6

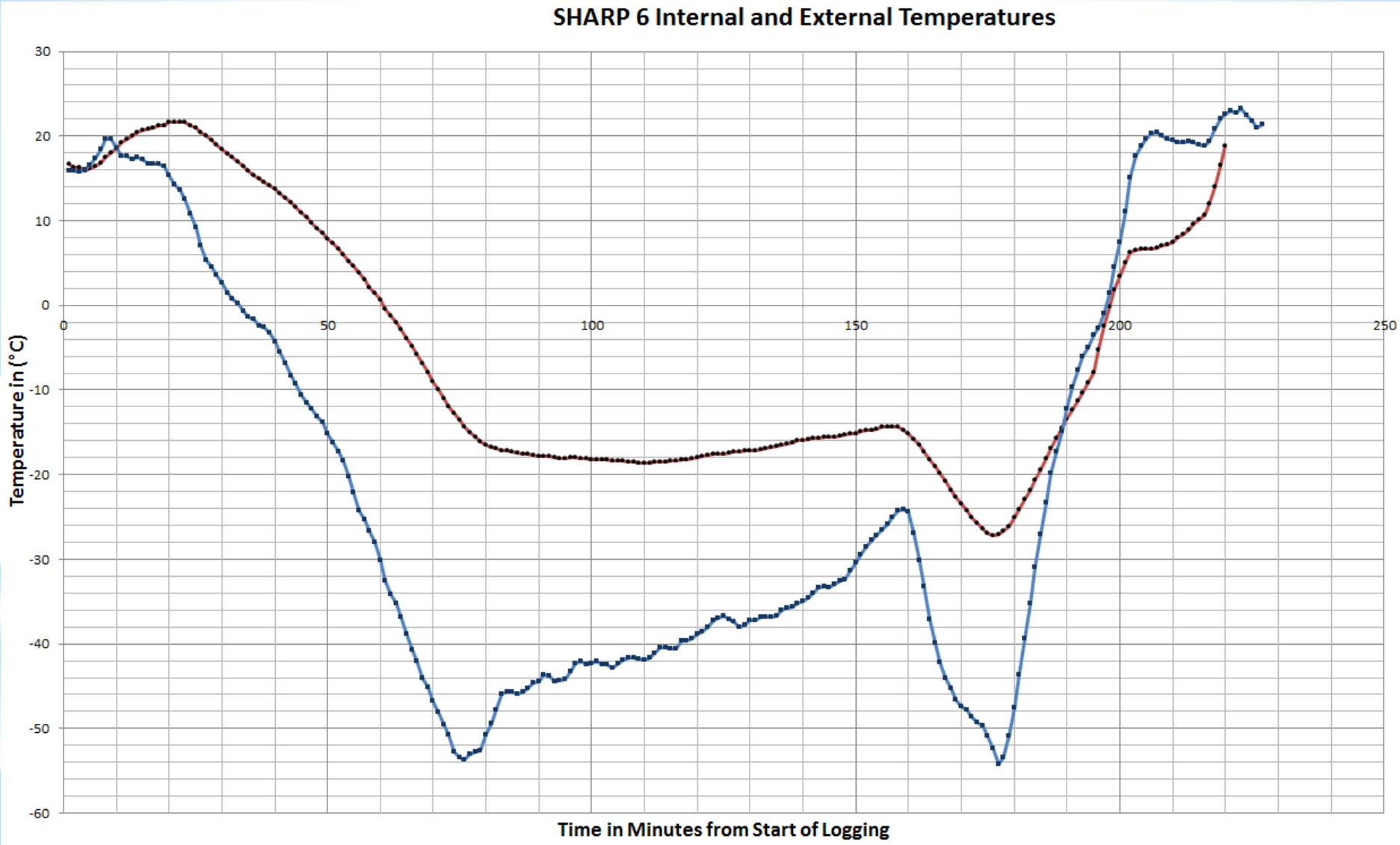
http://aprs.fi

Physics



APRS radio packets were transmitted and received for the entire flight.
Data included latitude, longitude, altitude and airspeed.

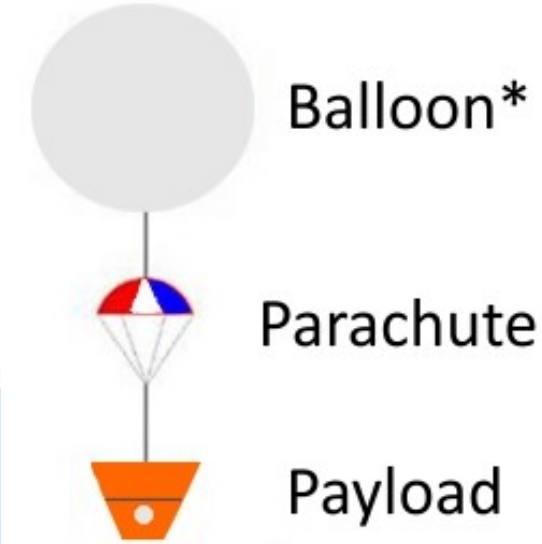
Atmospheric Science



SOAR-1 High Altitude Radio Repeater

Essential HAB Hardware:

1) A high altitude weather balloon (≈$150)*
2) A cylinder of compressed balloon grade helium (≈$150-300) *
3) A balloon filling tube ($50-100)
4) A parachute ($50 -100)
5) A video camera and SD card ($150)
6) An APRS tracking radio beacon, antenna, GPS receiver, battery pack and someone with an amateur radio certificate ($300)
7) Kite line (Dacron or Nylon string) and your payload ($50)



- *The balloon and the helium are lost on each flight.
- Minimum cost of first flight is about $1000.
- Minimum flight cost decreases to $300 – 500 afterwards.

1) The Standard Weather Balloon:

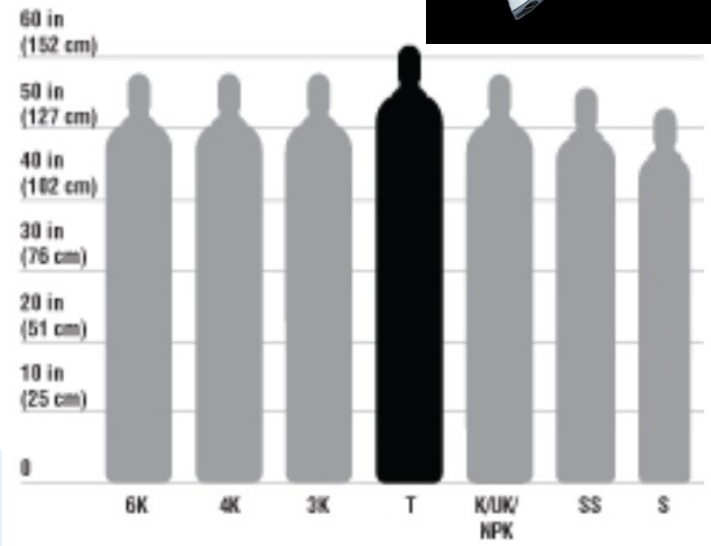
http://www.hoskin.ca

http://kaymontballoons.com/

	TA 1200
Colour	uncoloured/natural
Average Weight (g)	1200
Neck Diameter (cm)	3
Neck Length (cm)	12
Flaccid Body Length (cm)	226
Barely Inflated Diameter (cm)	144
Payload (g)	1050
Recommended Free Lift (g)	1190
Nozzle Lift (g)	2240
Gross Lift (g)	3440
Diameter at Release (cm)	179
Volume at Release (m^3)	2.99
Rate of Ascent (m/min)	320
Diameter at Burst (m)	8.63
Bursting Altitude (km)	33.2
Bursting Pressure (kPa)	0.73

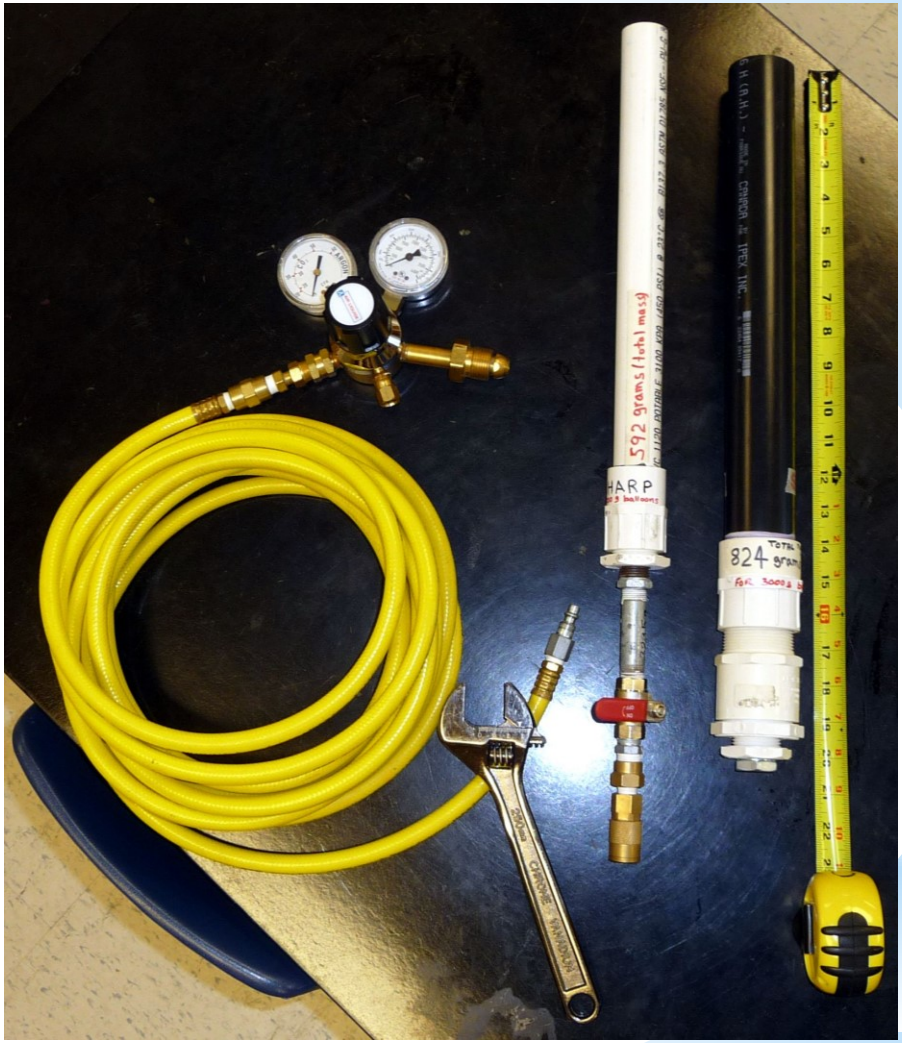
2) Helium

A T-cylinder of balloon grade helium will fill two, 1200 gram balloons (3 m^3 or 110 cubic feet). The gas is under great pressure and the steel cylinder is very heavy. Consult WHIMIS and order the gas early, consider storage and transport. Share a cylinder with another school? Bring a large adjustable wrench to the launch site.



3) Balloon Filling Apparatus

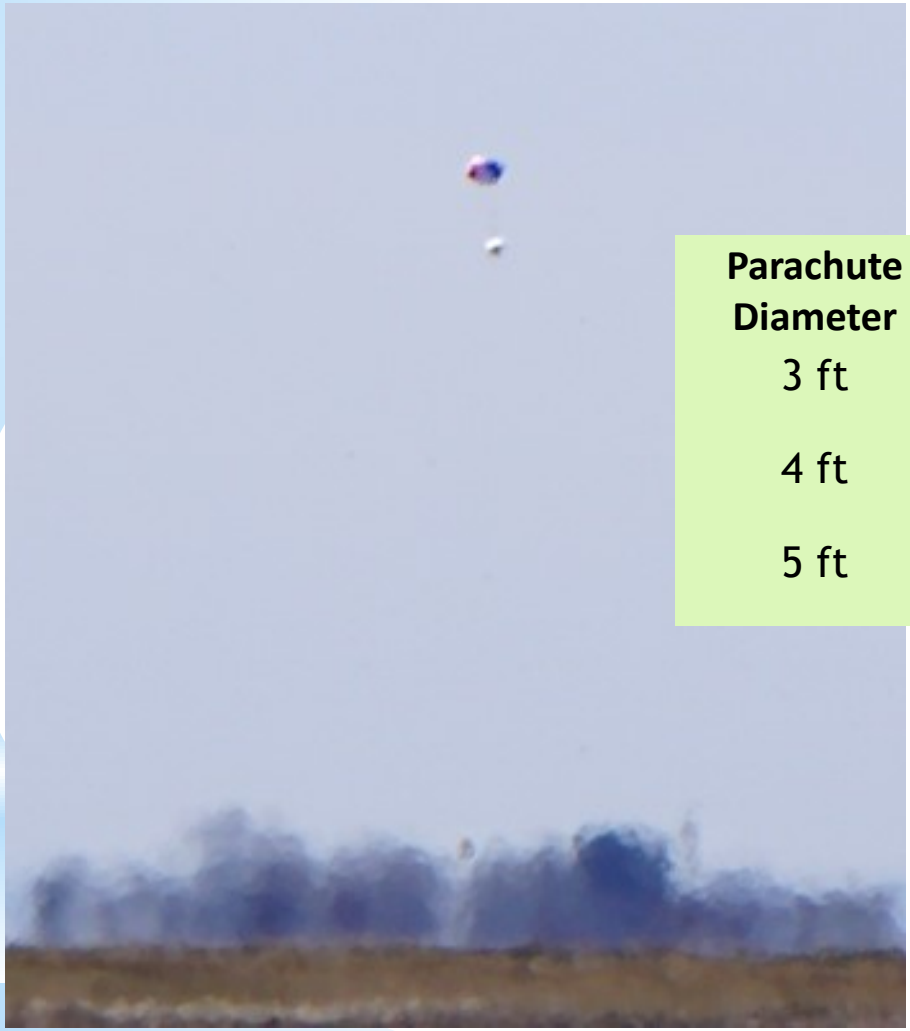
High Altitude Science
http://www.highaltitudescience.com/



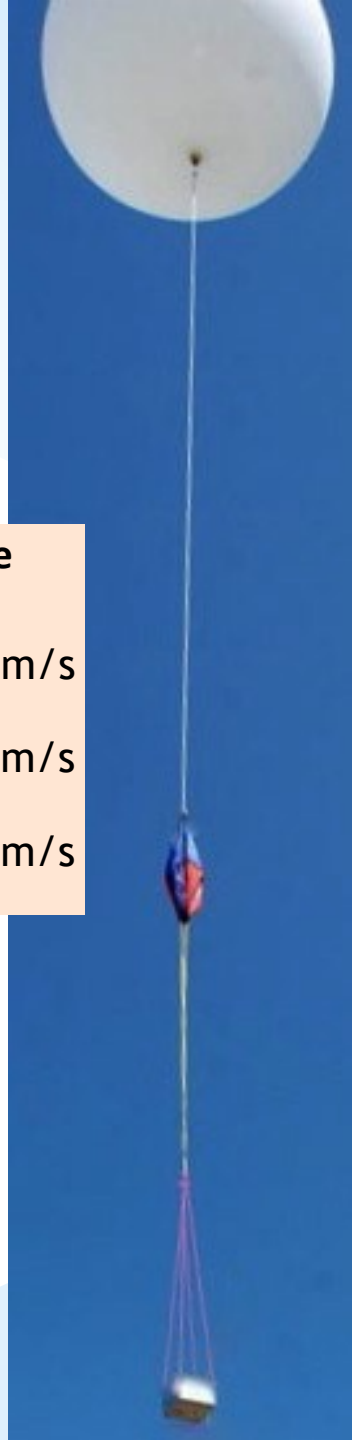
Shaftesbury High School Filling Equipment

4) Parachute

Buy or sew your own. Buying might actually be cheaper.



Parachute Diameter	Payload Weight	Descent Rate
3 ft	1.7lb/0.77kg	15.95ft/s=4.86m/s
4 ft	3.0lb/1.4kg	15.95ft/s=4.86m/s
5 ft	4.7lb/2.1kg	15.63ft/s=4.76m/s



http://the-rocketman.com/store.html

5) Video Camera

Recording the flight from inside your payload is a must. The Mobius Action Cam is simple and works well.

Mobius Action Cam

Measuring under 1 3/8″ x 2 1/2″ x 3/4″ inches and weighing only 1.4 ounces, this camera will capture stunning 1080 HD video quality.

6) An APRS Tracking Radio Transmitter

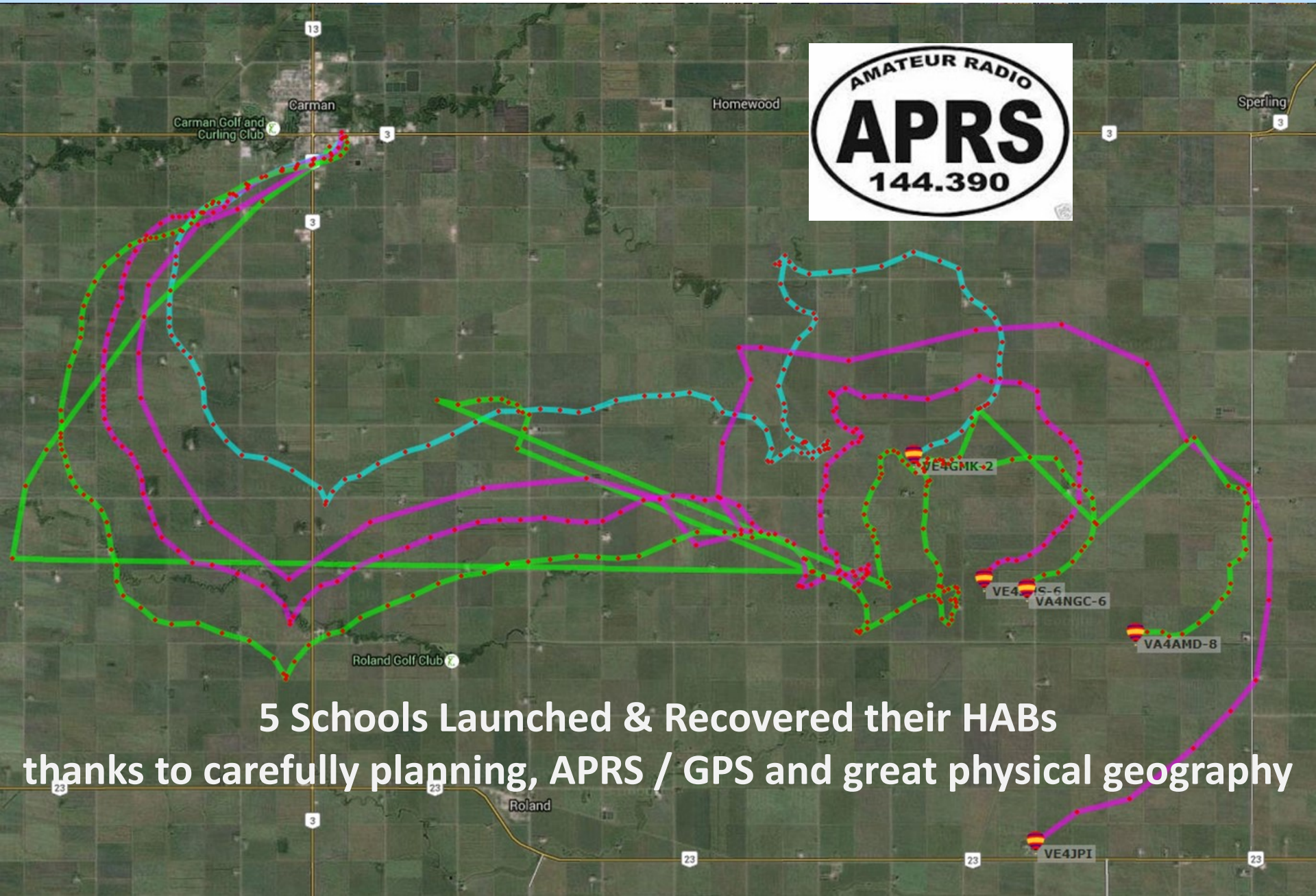
Micro-Trak RTG FA High Altitude Combo - $250. Ideal for high altitude balloons (HABs). Includes the built and tested frequency agile (144-148) Micro-Trak RTG FA, Byonics GPS4 high altitude receiver, V6 dipole antenna, and 12V cigarette lighter cable.

Weight is 6.1oz if GPS4 is replaced by GPS4OEM.

Note: This is an amateur radio transmitter. **You must be licenced to turn on this powerful radio transmitter.** Certification courses are offered twice a year by the Winnipeg Amateur Radio Club.

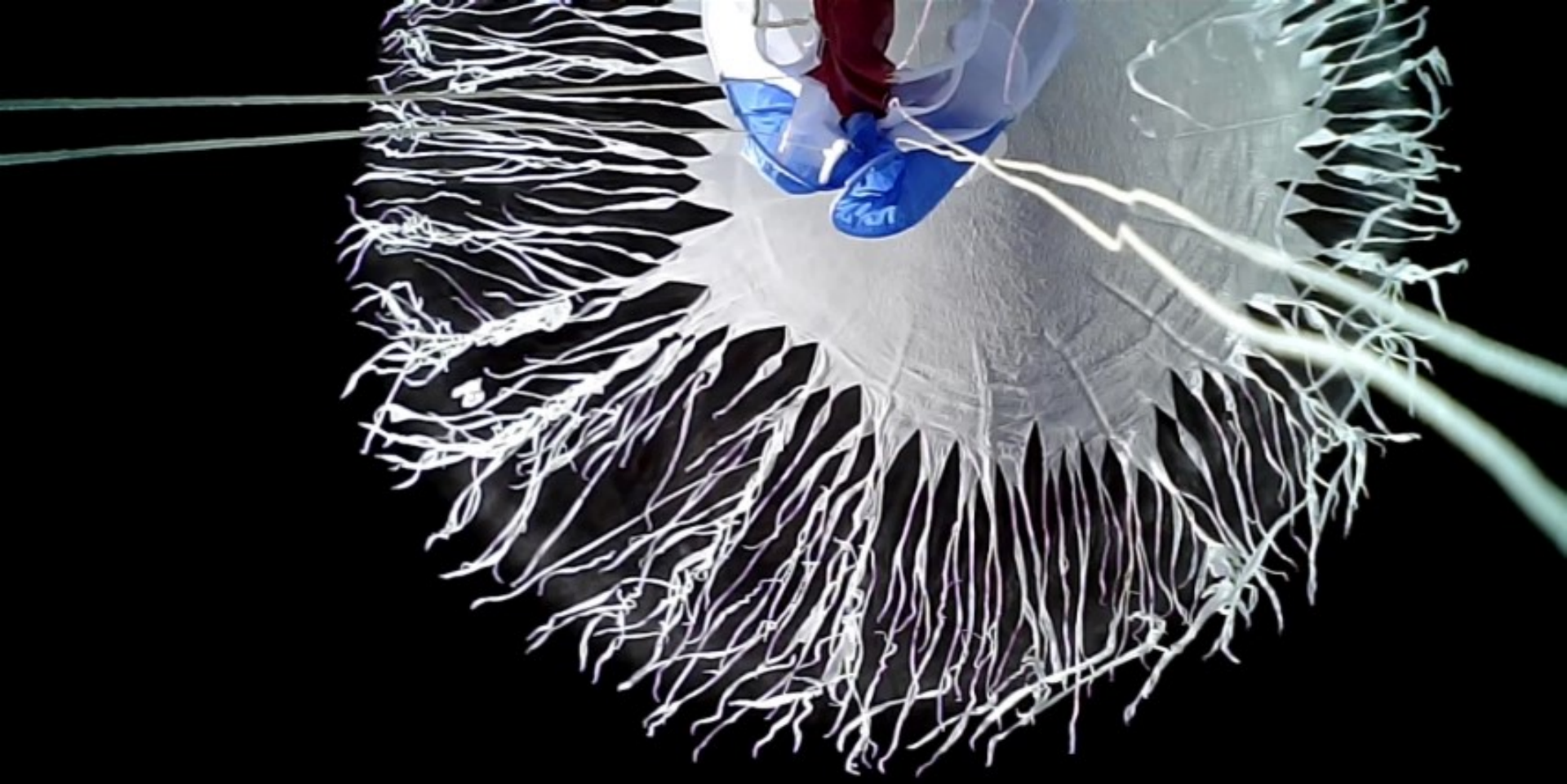
http://aprs.fi

April 29, 2016 Ground Tracks



5 Schools Launched & Recovered their HABs
thanks to carefully planning, APRS / GPS and great physical geography

7) Kite Line (Dacron or Nylon String) and Your Payload



http://shsballoonproject.pbworks.com

https://www.youtube.com/watch?v=6InyezkDgFU

Join Us!

What is Impossible?

Record Human HAB Jump