

HAB Flight Day 2018 – Radio Amateurs of Canada Report

The Manitoba Association of Physics Teachers (MAPT) coordinates an annual high altitude ballooning event for a growing number of Manitoba schools. The high altitude balloon or HAB flight is the climax of a yearlong STEM (Science, Technology, Engineering and Mathematics) project. A large helium filled balloon carries a student built payload to an altitude in excess of 30 kilometres or 100,000 feet. After the flight, students retrieve their HAB payloads containing their experiments, data loggers and video recorders. The projects often involve collaboration between the school's science and technology or industrial arts programs. MAPT also holds an HAB symposium once a year so students and teachers from all the schools can get together and share what was learned.



The Space Jimmies Used Student Daniel MacPherson's Call Sign, VE4CYN (Right Front Row) to Track Their R2D2 Payload

Many of the HAB students and teachers become certified amateur radio operators as each payload includes a Global Positioning System (GPS) receiver feeding data to a 2-m Automatic Packet Reporting System (APRS) amateur radio transmitter. The HAB's position, speed and altitude are transmitted every minute so the team knows where their HAB is. Amateur radio is also used to coordinate the teams at the launch site and while searching for payloads that have landed. The Winnipeg Amateur Radio Club (WARC) runs basic radio certification classes twice a year and there are usually a few HAB students and teachers in each class. WARC presents a trophy to a school for the “*Best Use of Amateur Radio in Support of HAB Flight Operations*” each year. RAC has also supported Manitoba HAB schools through Youth Education Program (YEP) grants.



MAPT's Annual HAB School Symposium (left) and WARC's "Best Use of Radio" Trophy (right)

HAB Flight Day 2018 was held on April 27th this year. Strong north winds predicted for the 27th meant the launch site had to be well north of Winnipeg. Flight predictions, run days beforehand, led to the selection of Alonsa, Manitoba as the primary launch site. The school principal in Alonsa agreed on short notice, to host our large group of grades 6 to 12 students and teachers and so the stage was set.

Thirteen school teams, consisting of roughly 200 students and teachers, began arriving in Alonsa at about 9:30 AM. The teams set up along a tree line seeking shelter from the gusting north wind. Balloons were inflated with helium and payload electronics were prepared for flight. The packet radio transmitters were checked and one by one the HABs lifted off. The St. James Collegiate team (Space Jimmies) launched first at about 11:45. Eventually, eleven of the thirteen teams launched their balloons. Two teams scrubbed for technical reasons but they will fly later.



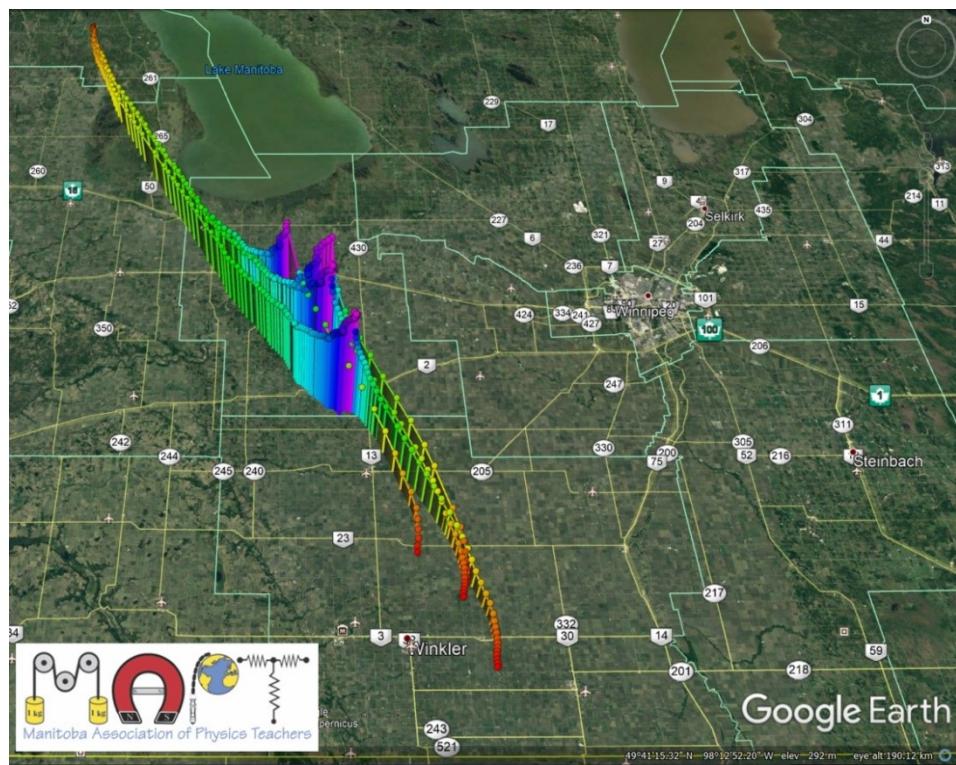
Eleven Manitoba School HAB Teams Preparing for Flight on April 27th

The flight track predictions (<http://predict.habhub.org>) were accurate. Most flights were only a couple miles from the predicted track. The range of the flights was variable as expected because

of the difficulty in measuring neck lift in the gusting wind. Some teams managed to make a good lift determination while others were really off the mark.

Parachute landings occurred along a line running from Elm Creek, Manitoba, all the way to Sherack, Minnesota (about 14 miles northeast of Grand Forks). The goal of our group was to achieve a 5.0 m/s ascent rate to produce landings near Carman, Manitoba. Most ascent rates were less than desired, resulting in landings further south and east in the Roland - Plum Coulee area.

A new team, Miles Macdonell Collegiate had a typical flight. Their ascent rate was about 3.7 m/s. Their HAB entered the polar jetstream at about 6000 metres. The highest wind speed recorded was 170 km/h at an altitude of 10,000 metres (about 33,000 feet). The Miles Mac balloon continued its ascent in the stratosphere. Above 25, km the wind is minimal. Atmospheric pressure decreases from about 100 kPa at the surface of the Earth to about 1 kPa at 30 km. The balloon is now the size of a small house. The Miles Mac balloon burst at a height just above 30 kilometres. The payload's parachute descent lasted about 30 minutes. The flight track length was 207 km.



Four of the Eleven School HAB Flight Paths Are Shown Above (April 27/18)

Some HABs strayed further west than expected and passed through but well above the air training area west of Southport/Portage la Prairie used by 3 Canadian Forces Flight Training School. All the payloads landed close to the predicted track but were spread out downwind over a surprisingly long distance.

Two payloads landed in the USA but were soon recovered. The Minnesota landing by new team, the University of Winnipeg Collegiate, is probably a range record for our group; about 350 km. Their payload was recovered by two teachers in a farmer's field in darkness late on the 27th.

After a failed attempt to cross the border by a Garden City team member, a phone call was made to a bar manager in Bathgate, North Dakota (population 43) to notify them of the nearby landing. The Garden City Collegiate payload (most of it) was quickly retrieved by patrons of Reiny's Bar. Their reward was a \$100 bar tab. These heroes were unavailable for thanking when, a couple days later, a teacher arrived at Reiny's to pick up the payload. A Mobius videorecorder, SD card and a small OLED display were lost.



Garden City Teacher Recovers Most of the School's Payload at Reiny's Bar in Bathgate North Dakota

Some teams lost APRS/GPS data immediately after their balloon burst, possibly because of the CoCom limits placed on commercial GPS receivers. The purpose of the Coordinating Committee for Multilateral Export Controls limits is to prevent the use of the GPS for weapons guidance and tracking by enemies. The altitude and speed limits are 18 kilometres (roughly 60,000 feet) and 1000 knots. Teams use GPS receivers which we know work above the 18 km limit. However, after the burst, a free falling payload could perform like a ballistic missile by falling at high speed from a great height. Exceeding both CoCom limits will cause the GPS receiver to reset and it may not re-achieve GPS satellite lock before the payload lands. We think that using slightly larger parachutes could solve this problem. Any reader with insight into this GPS issue, please weigh-in.



HC Avery Middle School's HAB 31 km Above Portage la Prairie Manitoba Looking North at the Big Lakes

Students are getting creative with their payload designs. A Star Wars theme was apparent this year. River East Collegiate flew a Death Star, Lundar, a Tie Fighter and St. James flew R2D2. This was not planned but added to the festive vibe at the launch site.



River East Collegiate Team before the Launch of Their Death Star Payload

More HAB flights will follow over the coming weeks. Immanuel Christian School made a successful flight on May 2nd using teacher call sign VE4KAV. They launched from Carman Collegiate and they recovered their payload in a farmyard northeast of St. Anne, Manitoba. The highest altitude achieved this year was by a Lundar HAB flown on May 11th. Its GPS receiver gave a peak altitude of 33.74 km or 110,700 feet.

MAPT will conduct team surveys soon with the goal of improving operations on flight day. MAPT hold teacher HAB workshops during the 2018-19 school year. We eagerly await the student's presentations, based on the many experiments flown, at the next Manitoba Schools HAB Symposium.

The Prairie Provinces are well suited to flying school HABs/STEM projects but other regions and other types of flights could work too. Circumnavigating super-pressure balloon flights are becoming more common (<http://www.scientificballoonsolutions.com/news/>). Forestview Middle School in Baxter, Minnesota, using teacher Corey Olson's call sign, KD0VJI-11, recently flew a 13 gram payload for 31 days. It circled the northern hemisphere four times before it was lost. This school HAB was probably more useful in teaching geography than science and engineering but the point is; vehicles like balloons and amateur radio can provide high interest, hands-on learning opportunities. The APRS infrastructure is worldwide and available for free to support educational projects such as HAB flights. Certainly, the importance of amateur radio to our STEM projects is obvious and valued by our students.

The Manitoba HAB school students and teachers appreciate the commitment of radio amateurs who operate APRS gateways and digipeaters in Manitoba, North Dakota and Minnesota such as VE4HEK, VE4DPR, VE4TV-10, VE4CP-B, VE4SMA-3, VE4BCN-10, VE4GIL-3, VE4GLS, W0KGW-10, N0RNB-5, N0QXM, KC0SD-3 and others. Without them, we could not track our flights or acquire much of our flight data. Thank you and please keep your APRS rigs running!

More information on the Manitoba Association of Physics Teachers HAB project can be found on our web site: <https://mapteachers.wordpress.com/hab>

73

Robert Striemer (VE4SHS)