INDEPENDENCE AMATEUR RADIO CLUB (IARC)

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INFORMATION FOR HAMS – CROSSBAND REPEATER, TRACKING, BEACON

HIGH-ALTITUDE BALLOON LAUNCH AT INDEPENDENCE, KS, JUNE 4, 2022

The Independence Amateur Radio Club (IARC) will launch a high-altitude weather balloon from the lawn of the Oval at Riverside Park in Independence on Saturday, June 4, 2022, at 9:30 AM. The balloon carries an array of radios and equipment (the "payload") that will ascend to 80,000 feet or higher, where it will burst, and the payload will descend back to Earth for recovery. If weather conditions prevent launch, the event will be re-scheduled.

This document describes information for Hams who are in the coverage area to be utilized during the flight to communicate with the crossband repeater, track the flight using APRS and monitor the "find me" beacon. Web links to the various references used herein are included at the end of the document.


<u>The Flight</u>

IARC has been planning and building for this event for a few months in preparation for the flight. We anticipate the weather and wind forecast will hold, so the launch SHOULD occur at 0930 hr CDT from Independence, KS. We use balloon predictor software that looks at the weather forecast and winds aloft to plot the likely path the day of launch. At the time of this writing, the flight is predicted last approximately 1 hr 37 min, with a planned ascent rate of 5 m/sec and a descent rate of 15 m/sec and a burst altitude of 25,000 m (82,500 ft). Changes to these rates and actual altitude reached, plus weather forecasts will determine the flight path and landing site. Figure 1 shows the predicted path as of the time of this writing.

The launch team will setup the launch site at Riverside Park early Saturday, including the balloon fill and payload attachment, our base station radios for running net control with the CBR (147.91 MHz uplink / 449.01 MHz downlink) and talk-in or our local repeater (145.49 MHz, -offset, tone 91.5).

We will setup on the grass Oval that is on the east side of the playground and carousel. This is a wide-open area void of trees. Winds are forecast from the south, so the launch will track north initially. Net control will operate at the Oval and emcee the event at the Park.

The flight path will pass directly over a few towns in SE Kansas, going from western horizon to the zenith, then back to eastern horizon on landing similar to low-earth orbit satellite.

Crossband Repeater

Fig. 1 – Balloon predicted path as of June 1, 2002
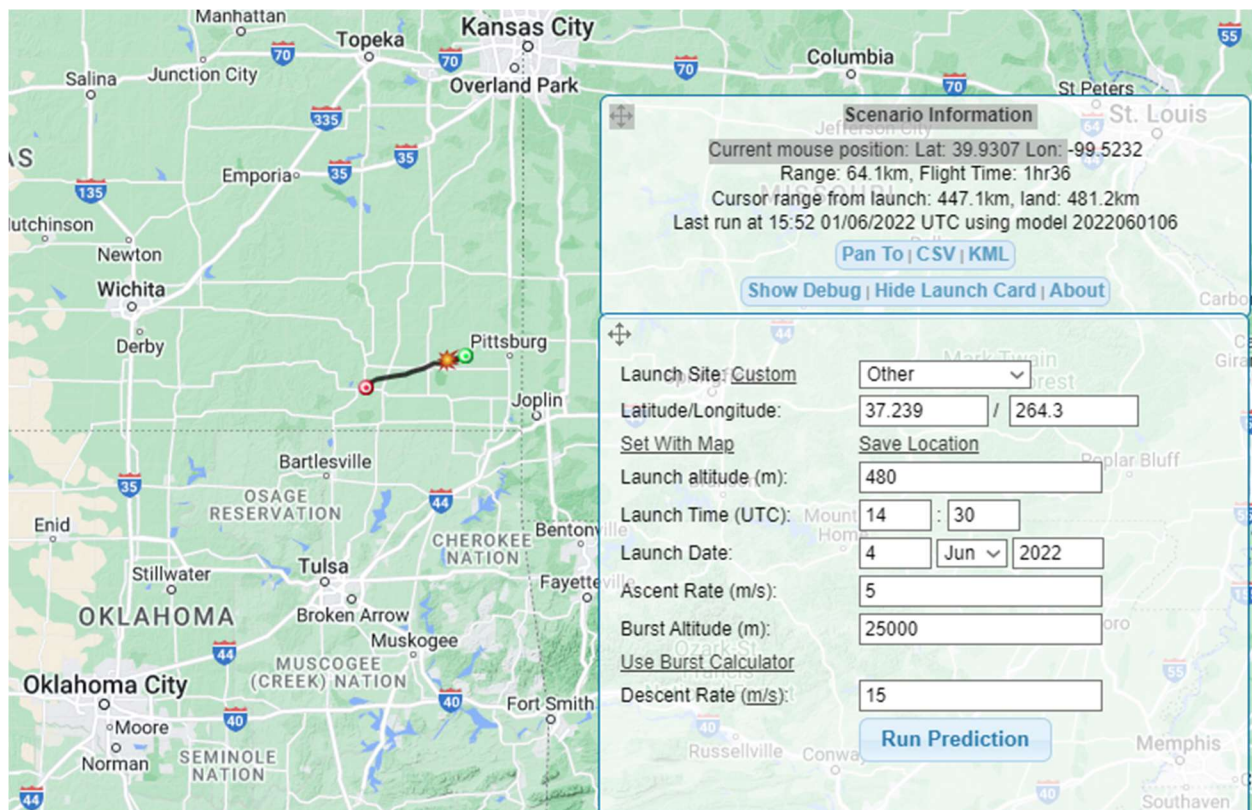
The Crossband Repeater (CBR) is a transceiver that receives a radio signal on one frequency from a ground station (the uplink) and re-transmits the audio received on another frequency (the downlink). To minimize size and weight, two frequency bands, 2 meters and 70 cm, are used for uplink and downlink. This avoids use of a duplexer.

In the balloon CBR we chose 147.910 MHz for the uplink and 449.01 MHz for the downlink. These are amateur radio repeater frequencies, so a check was done to see if there would be interference on either of these frequencies – no frequencies near these were found to be used in the central US.

Fig. 2 – Balloon Crossband potential range

Our receiver radio has a 12 dB SINAD (a measure of sensitivity) of -118 dBm. Our transmitter is 5 watts, so at altitude, we should be able to hit ground stations up to 300 miles from the launch point of Independence, KS. Antennas are vertically polarized but will sway in the wind.
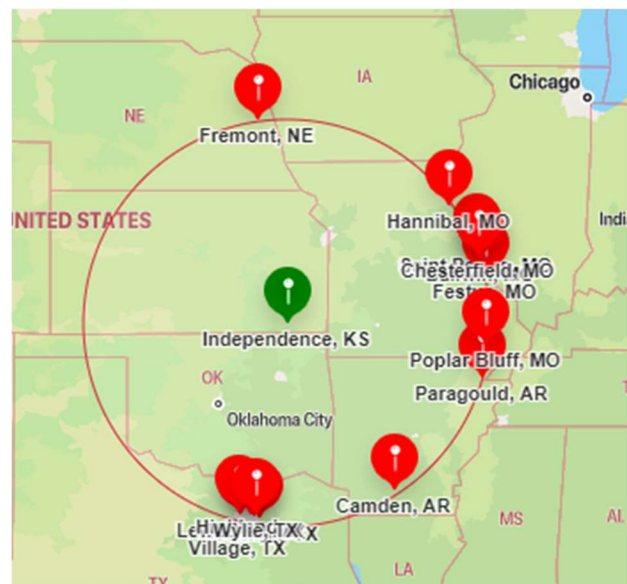
To communicate with the CBR, set your transceiver to 147.91 MHz transmit and 449.01 MHz receive, no tone. On my ICOM IC-2730A, I set receiver #1 to 449.01 and receiver #2 to 147.91. I then select #2 to MAIN, which means when I transmit, it will use the #2 frequency.   Your radio will vary on settings. I have a Baofeng HT that accepts a 301.1 offset that will be at the Park for Hams present to try to talk to the CBR. Check your respective radio manual.

If you have issues using CBR, simply tune to the 449.01 MHz and listen to the downlink. Email me (listed at the top of this document) to let me know your location and comments.

To reach the CBR on the balloon, a yagi or similar antenna may be needed. Your location will determine direction and azimuth for the antenna, so use APRS to find the lat/long and altitude (see the next Section in this document). If you are close to the balloon, say less than 100 miles, you may want to calculate the angle to the CBR using trigonometry (elevation angle is *=deg(atan(altitude/distance))* in Microsoft *Excel*, use same units). Your bearing is from the APRS tracking, estimate the bearing should get you close.

Fig. 3 – Elk Log Periodic antenna and stand

Hams at a distance should be able to point toward the balloon location and your antenna main lobe should hit it, maybe use a slight elevation.

Hams very close-by, particularly in Parsons, should be able to use an HT. Try turning the antenna perpendicular to the CBR.

For use during the flight, I will use an Elk #2M/440L5BB Log Periodic antenna with a homebrew PVC pipe stand.   This antenna covers both 2m and 70 cm bands and has decent gain. The stand makes it easy to set the bearing and azimuth during the flight (no joints are glued). AE0LM will run net control and log using Netlogger if you want to follow along.
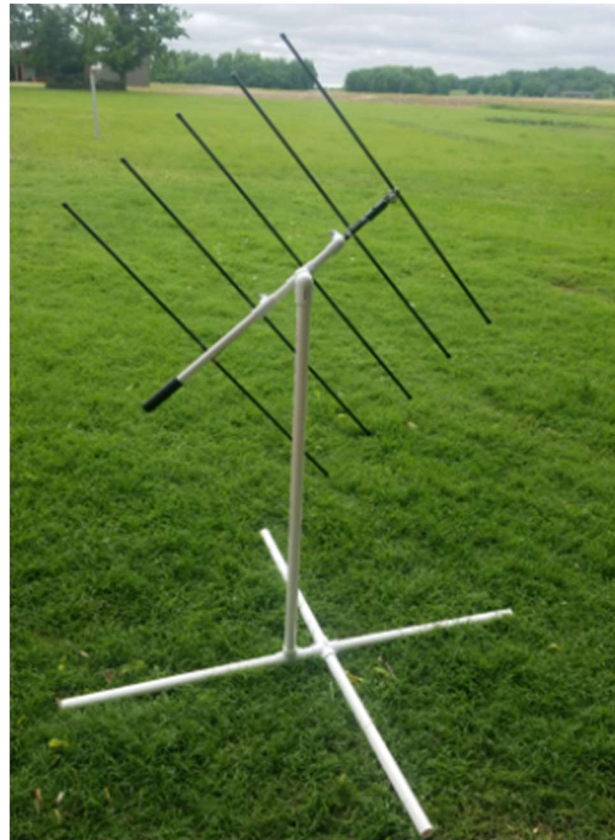
APRS Tracking

Since our flight is relatively short duration, we will fly an APRS transmitter that will send lat/long, altitude, temperature and barometric pressure to APRS digipeaters and I-gates in the SE Kansas, NW Oklahoma and SW Missouri areas. This information is sent to the APRS-IS (Internet System).

The balloon APRS ID is **AC0AE-11** and its symbol is a balloon. The website www.aprs.fi is an easy-to-use way to track APRS devices, in this case the balloon. The figure below shows a screenshot

of a test of the AC0AE-11 device. As you can see, the balloons position on the map is show. If you click the balloon, the altitude and other information is shown in a pop-up.
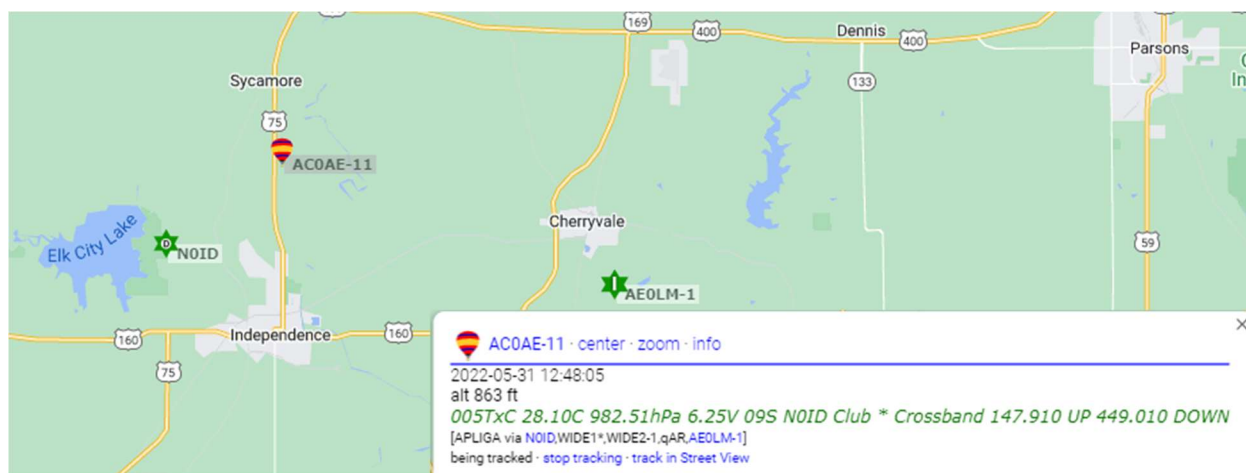

Fig. 4 – aprs.fi showing AC0AE-11 and information

The upper right of the aprs.fi screen has the controls and entries for the APRS information. You may enter "AC0AE-11" and I recommend Show last: and Track tail length: of 6 hours, as this will show the balloon track for the entire flight, then Click Search. The APRS device will be activated approximately 0900 on Saturday, so if it is not registered on the APRS-SI it will show old data as above, so just standby until activated.

Fig. 5 – aprs.fi setup for AC0AE-11

For APRS gurus, the beaconing on the AC0AE-11 device are set so that it limits digipeats to only <u>one</u>, when the altitude is above 3000 feet to prevent flooding the APRS-SI, since it has the possibility of hitting digipeaters hundreds of miles away. Experiment with aprs.fi to become familiar with its usage.

Use of the APRS information

First, **hams wanting to communicate on the CBR** can use this information for aiming their antenna at the balloon, to either communicate or just listen.

Second, **the base station at the Park will have this display running live** to show folks there where the balloon currently is and how high.

Third, the recovery **chase teams will use aprs.fi on their smartphones** to track location, burst and descent. As a local ham told me, the balloon has the ability to land in the exact center of a mile section that is fenced with KEEP OUT signs posted.

Balloon burst and the "Find-me" Beacon

The latex balloon expands as it ascends and will eventually burst. The payload will freefall to approximately 1000 feet above ground where a parachute will deploy for gentle and safe landing.

There is a low-power VHF transmitter (145.565 MHz FM) the chase teams will use to find the eventual landing site for the payload. **If area and distant hams can listen at this "find me" frequency during the flight and let me know by email (top of this document) your location and what your heard (morse code) that would be greatly appreciated.**

IARC club held a "Foxhunt" recently – find a hidden transmitter, for club members to practice finding a transmitter as we will be doing in recovery. We have various types of receiving devices, so happy hunting teams!

Conclusion

Everyone is invited to Riverside Park to participate, but if unable to attend, the balloon geo-positioning can be followed on a computer or smartphone from home. All Hams are invited to talk and listen to the balloon – see the IARC website for details about the balloon repeater.

Furthest QSO with CBR will receive a "special gift" and other consolation prizes may be awarded as the judges determine, within the Amateur Radio code of conduct, so have at it and have fun!

Also let us know if you can help if the balloon landing site is in your area as we might need to contact a landowner for access to the payload.

More information about this event (including weather re-schedule) and details of the equipment, go to the IARC website at www.n0id.org or contact AE0LM@protonmail.com or BretChilcott@gmail.com by email.

Reference – for your information only, I have no vested interest in any of these

IARC web site – www.n0id.org

Netlogger web site to download the logger application for your PC – https://www.netlogger.org

Balloon Predictor for balloon launch. Re-run this day of launch to get best prediction - http://predict.habhub.org/#!/uuid=0b170629ec3a8ee6f0b3db8693251cb1c410975d

APRS tracker for the balloon – AC0AE-11 with 6 hour track and tail – https://aprs.fi/#!mt=roadmap&z=11&call=a%2FAC0AE-11&timerange=21600&tail=21600

Elk Antenna dual-band log-periodic antenna - https://elkantennas.com/product/dual-band-2m440l5-log-periodic-antenna/

> **Crossband Repeater** – Uplink 147.910 MHz, Downlink 449.010 MHz no tone
>
> **Independence Talk-in Repeater** – 145.490 MHz, -offset, tone 91.5
>
> **"Find Me" Beacon frequency** – 145.565 MHz FM