

Weather Balloon Space Probes

Sense, signal, and snap photos in the stratosphere.

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A bunch of hackers drive into the desert with a trunk full of equipment: a weather balloon, a tank of helium, and a styrofoam cooler loaded with cameras and sensors. After filling the balloon, they release it and watch it hurtle skyward, the cooler and a parachute dangling beneath.

The hackers track the balloon on laptops as it rises to black-sky altitudes 20 miles up, whereupon the balloon bursts and the payload floats down. Team members on dirt bikes race to recover the package, checking their mobile phones for SMS texts containing GPS coordinates of the landing site.

While this sounds like a scene from some hacker novel, launching and recovering near-space balloon probes is easier than ever, and dozens of amateur groups — ham radio enthusiasts and hackers alike — are doing it now.

E Cut-Down

Legal flights require a cut-down mechanism to separate the balloon from its payload and parachute after a set time or in response to a signal. One simple cut-down circuit uses a relay to discharge a dedicated 9-volt battery through a high-resistance Nichrome wire coil that's wrapped around a nylon cord. Close the relay, and the coil melts the cord.

F Enclosures

An enclosure protects payloads from the extreme temperatures of the upper atmosphere and the impact of hitting the ground. Most amateurs use a foam cooler or construct an enclosure out of extruded polystyrene (XPS), which costs a pittance and doesn't crumble. You can also use small Pelican cases (pelican.com, prices vary) to protect individual devices, but this adds weight. A coat of day-glo paint will make enclosures easier to spot; be sure to write your phone number prominently on the outside of all enclosures.

G Telemetry

You may be able to eyeball your probe until it lands, but a balloon can travel many miles, particularly in strong winds. Here are three popular lightweight tracking solutions:

- » The OpenTracker+ kit (argendata.com, \$32), which interfaces with APRS (aprs.org), the tracking system used by hams
- » G1 Android smartphone with the Icarus app (noisebridge.net/wiki/icarus), which collects GPS info and sends the coordinates in a text message every 60 seconds
- » Spot personal tracker (findmespot.com, \$200, including one year of service)

Recovery

Once the payload deploys, you have to find it — even if it's miles away from the launch site. Terrain and roads permitting, you might be able to follow the flight with chase cars or motorcycles. Otherwise, you'll have to rely on tracking, good luck, and the kindness of strangers.

Regulations

Be sure to follow FAA regulations regarding launch sites and notifications, payload weight and density, and cord strength and cut-down mechanisms. Refer to the Society for Amateur Scientists guide at makezine.com/go/balloonfaa

For other resources, including additional references, trajectory predictors, FAA contacts, and a list of regional balloon launch groups and recent launches, see makezine.com/24/weatherballoons

Make:
SPACE

A Balloons

Most groups choose the Kaymont 1.500g sounding balloon (kaymont.com, \$105). It's relatively inexpensive, can lift 3.8kg, and is rated for a bursting altitude of 34.2km, or more than 110,000 feet. (It's possible, but not recommended, to eke out more lift by overinflating your balloon.) For helium, rent a tank from a local industrial/medical gas supplier.

B Radar Reflector

To make your balloon more visible to other aircraft, you may want to dangle a radar reflector from it, like the lightweight Emergency Radar Reflector from Davis Instruments (makezine.com/go/davis, \$30).

C Parachutes

A typical choice is a 5' parachute rated for 4.7lbs from Rocketman (the-rocketman.com/recovery.html, \$50). If in doubt, order the next size up — most chutes let you change the canopy size by adjusting the shroud lines. For the cord, you can use mil-spec nylon paracord rated for 95lbs. A 100' spool, more than enough for any balloon project, should cost less than \$10.

D Instrumentation

Common instrumentation includes still and video cameras, and devices for measuring and recording humidity, altitude (or air pressure), temperature, acceleration, and magnetic field. For power, you'll want lithium-ion batteries rated to -40°C; you can test devices inside a cooler with dry ice and fans. When choosing instrumentation, make sure your total payload will weigh less than what the balloon can lift. You can use the free Canon Hack Development Kit (chdk.wikia.com) to control PowerShot cameras, or the lightweight BalloonSat Mini controller (nearsys.com, \$19) to operate three sensors and a camera. Both are programmable in BASIC.

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