



# Send an Amateur Radio Balloon around the World

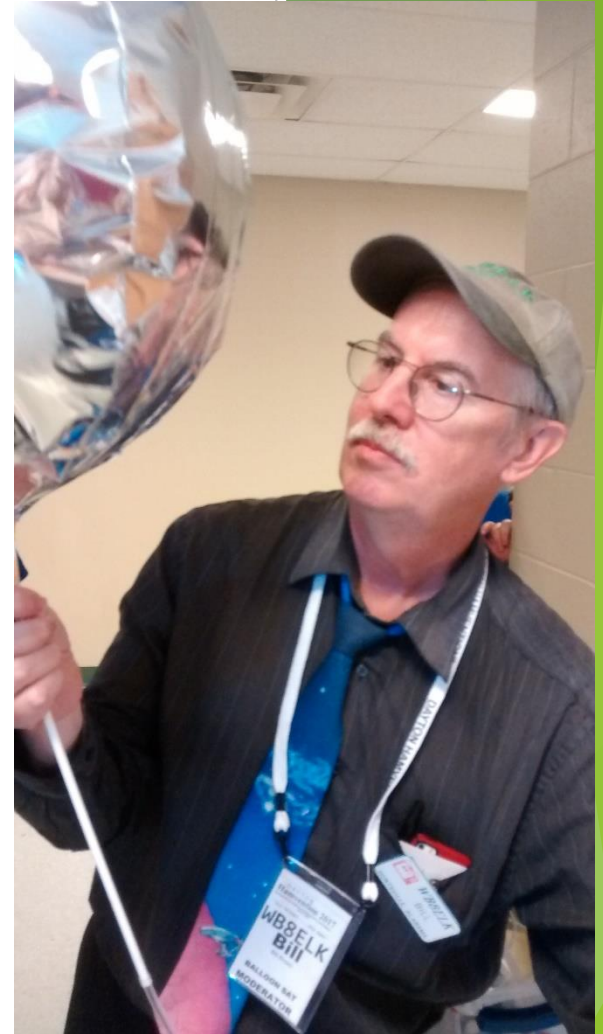
Bill Brown WB8ELK

August 8th and 9th, 2020

# Bill Brown WB8ELK

- Ham since 1969
- Pioneer in Amateur Radio High Altitude Ballooning (ARHAB)

Bill launched his first balloon into the Stratosphere carrying an Amateur TV transmitter and 2m beacon 33 years ago and has been instrumental in using ARHAB flights to encourage STEM education. He has flown over 600 flights since 1987.



# Around the World in 14 days

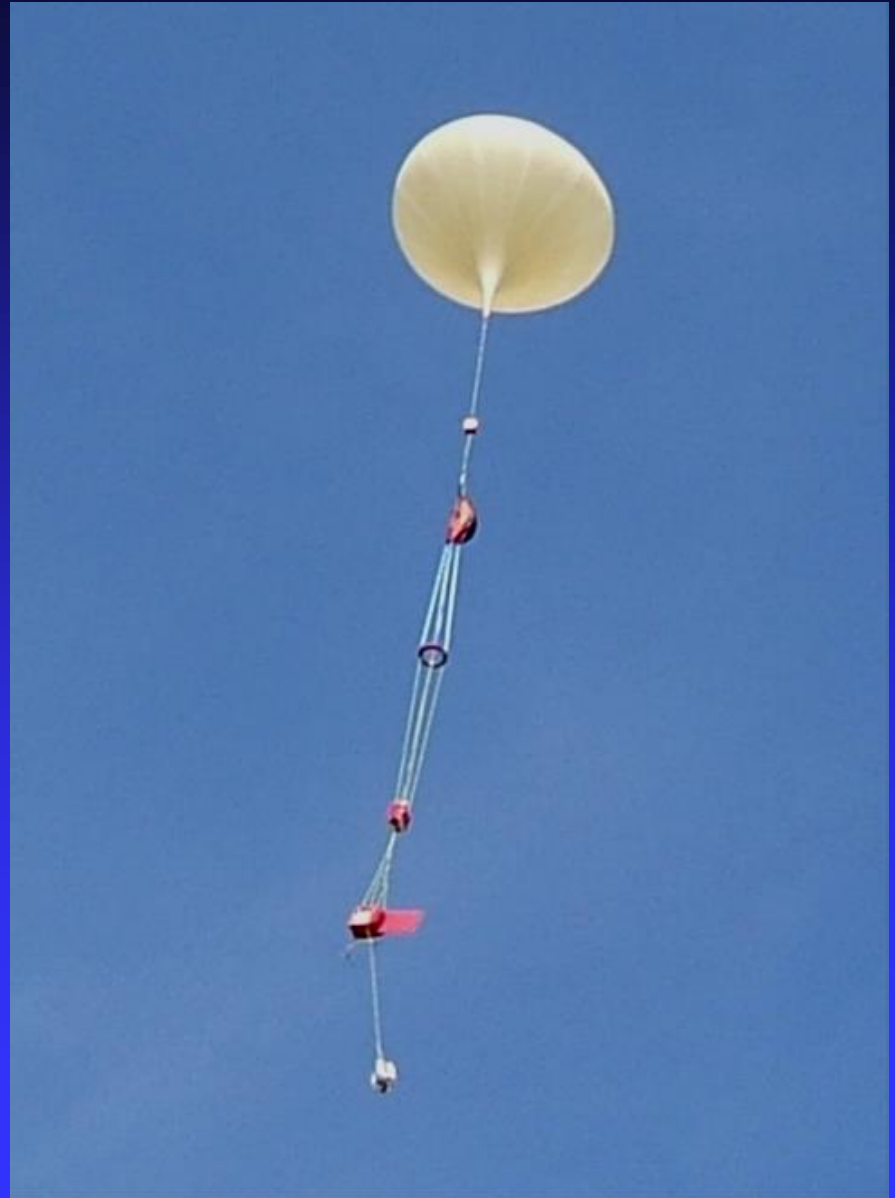


Send an amateur radio balloon around the World

# Typical Amateur Radio latex balloon

## Flight Train:

- Balloon
- Nichrome cutdown
- Parachute
- Primary APRS
- ATV payload
- Secondary APRS





# UAH Student Flights



Most creative payload design



# Simplex Repeater



# Entering the Stratosphere



WB8ELK, KD4STH and KD0QCA balloon  
photographed by Jeff Ducklow N0NQN at  
53,000 feet.

# The view from 85,000 feet



GoPro image over northern Alabama



# Student Science Experiments

>> **Very Angry Bird** <<



# This very rarely happens



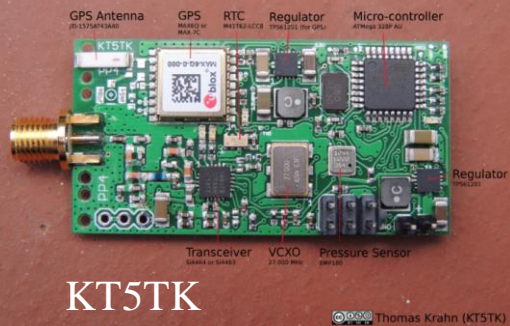


These are the usual  
landing sites for  
balloon payloads





## Pecan Pico 4



# Pico Balloons



Leo M0XER  
61.0 x 10.5mm



Andy VK3YT  
61.0 x 12.7mm

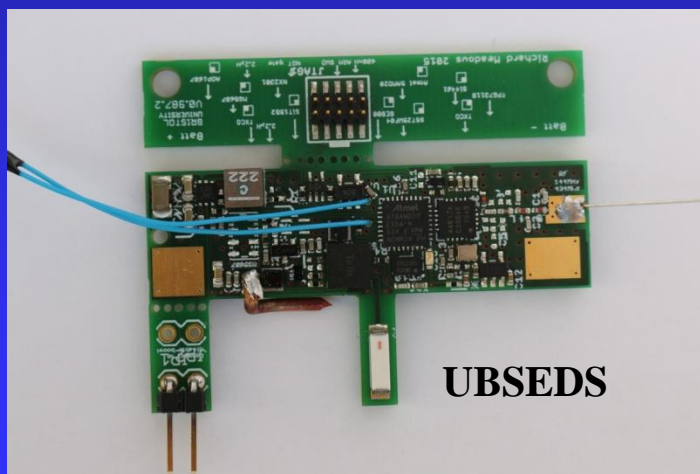
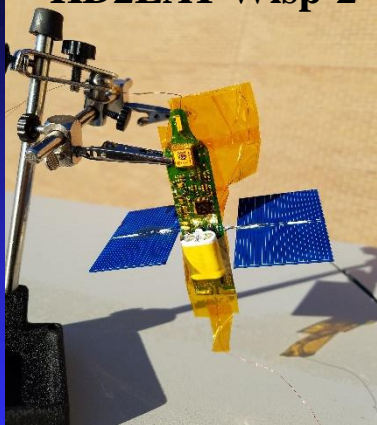


QRP Labs U3B  
33.8 x 12.7mm

## W7QO



## KD2EAT Wisp-2



A handful of hams around the World are developing trackers that weigh less than an ounce.

# Pico Balloons



KD2KDD  
KN4IUD



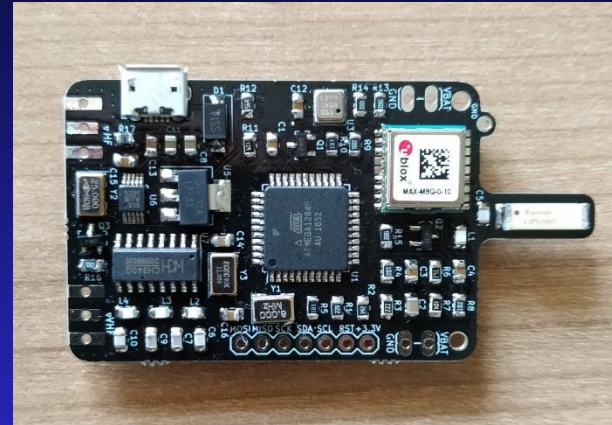
A handful of hams around the World are developing trackers that weigh less than an ounce.



# Pico Balloons



YO3ICT



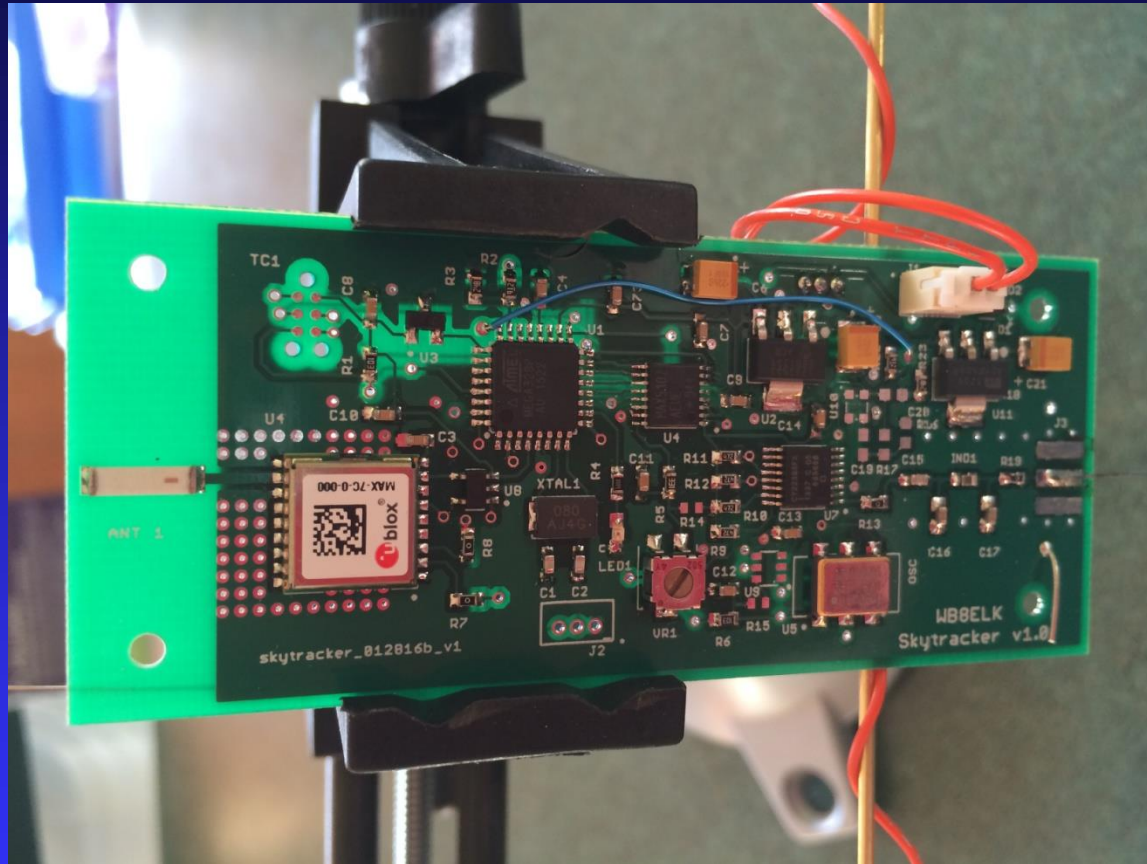
Light  
APRS



Pico  
APRS Lite  
DB1NTO

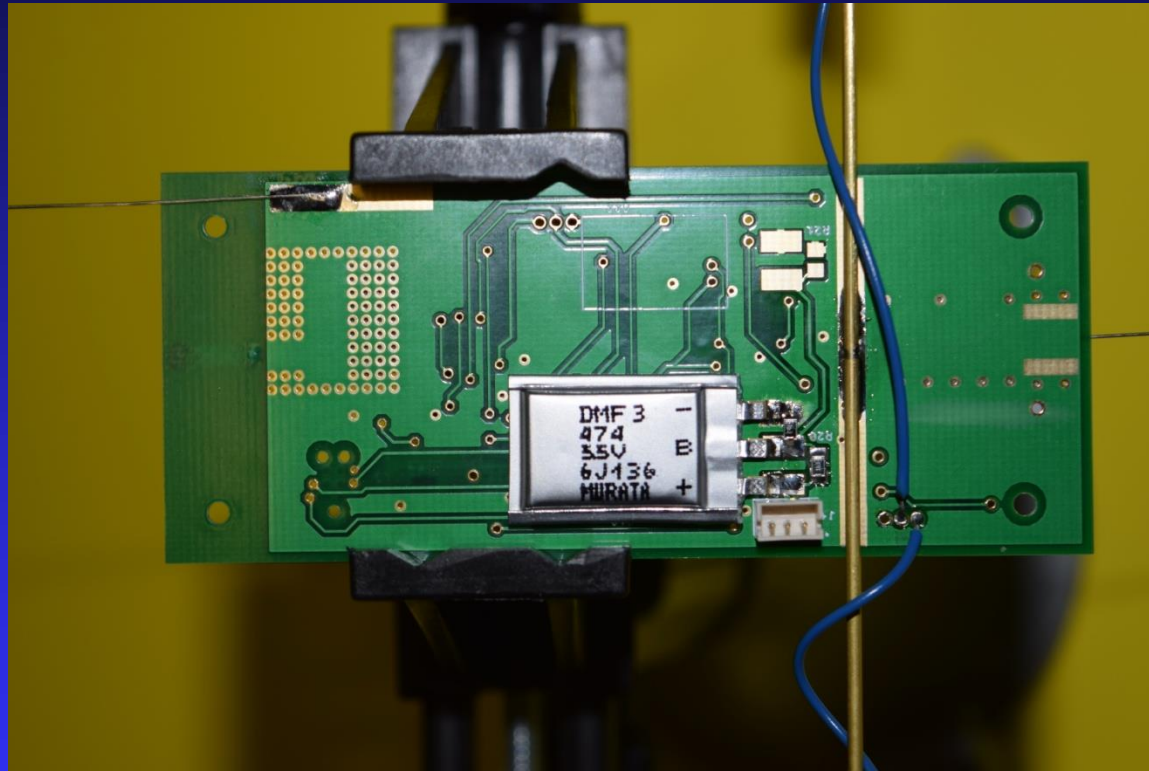
A handful of hams around the World are developing trackers that weigh less than an ounce.

# Pico Balloons



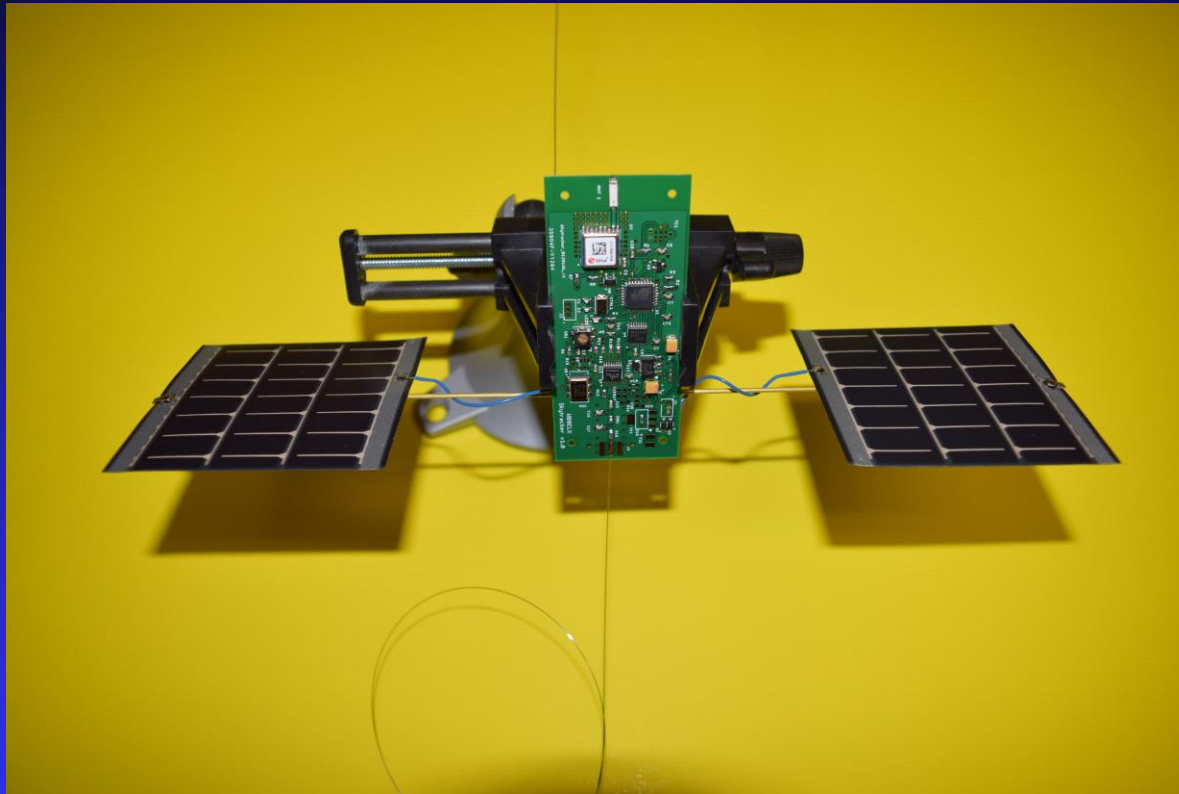
Designed a board called the Skytracker. Complete tracker with onboard GPS that can transmit on VHF or HF frequencies. APRS or WSPR modes.

# Pico Balloons



The 0.47 Farad Supercap on the back is very lightweight.

# Skytracker



Totally solar-powered using very lightweight thin-film flexible solar cells by PowerFilmSolar.



# Pico Balloons



Small size makes this an ideal STEM student experiment.



# Pico Balloons



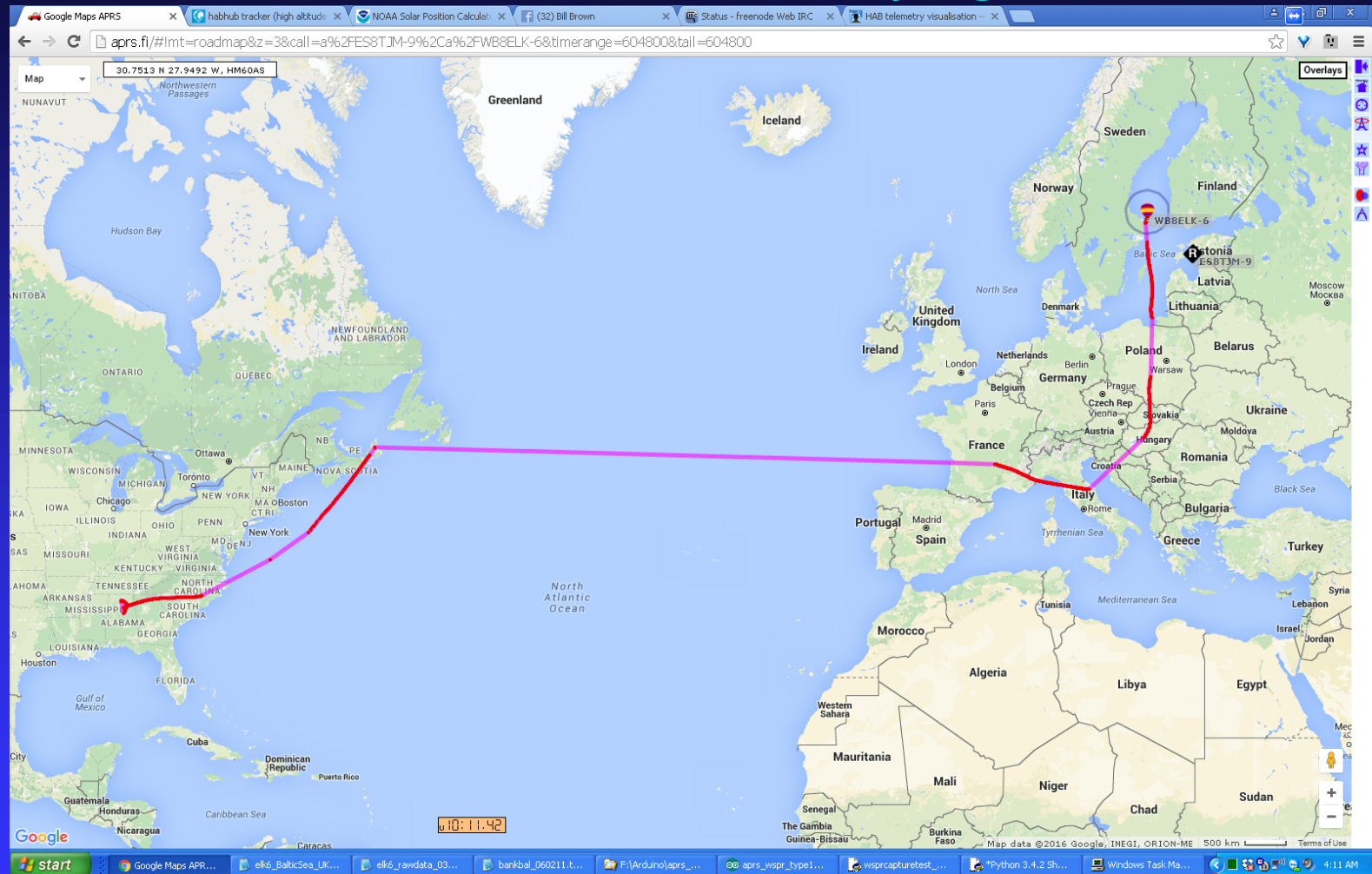
Easily launched by one person in a moderate wind.

Small 40 cubic foot tank of helium can be obtained at low cost



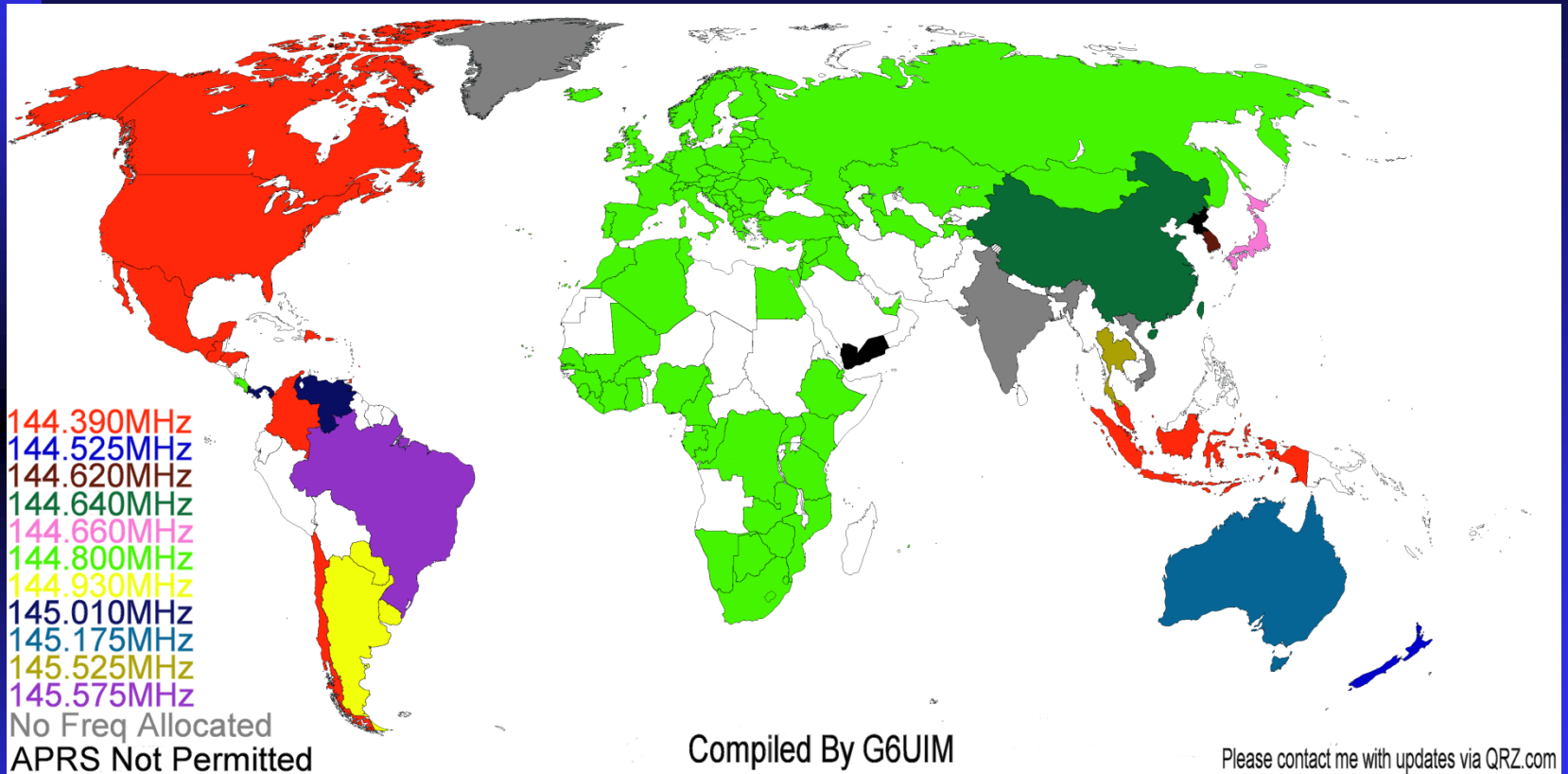
Easy to transport – can inflate 20 flights or more

# How far can they go?



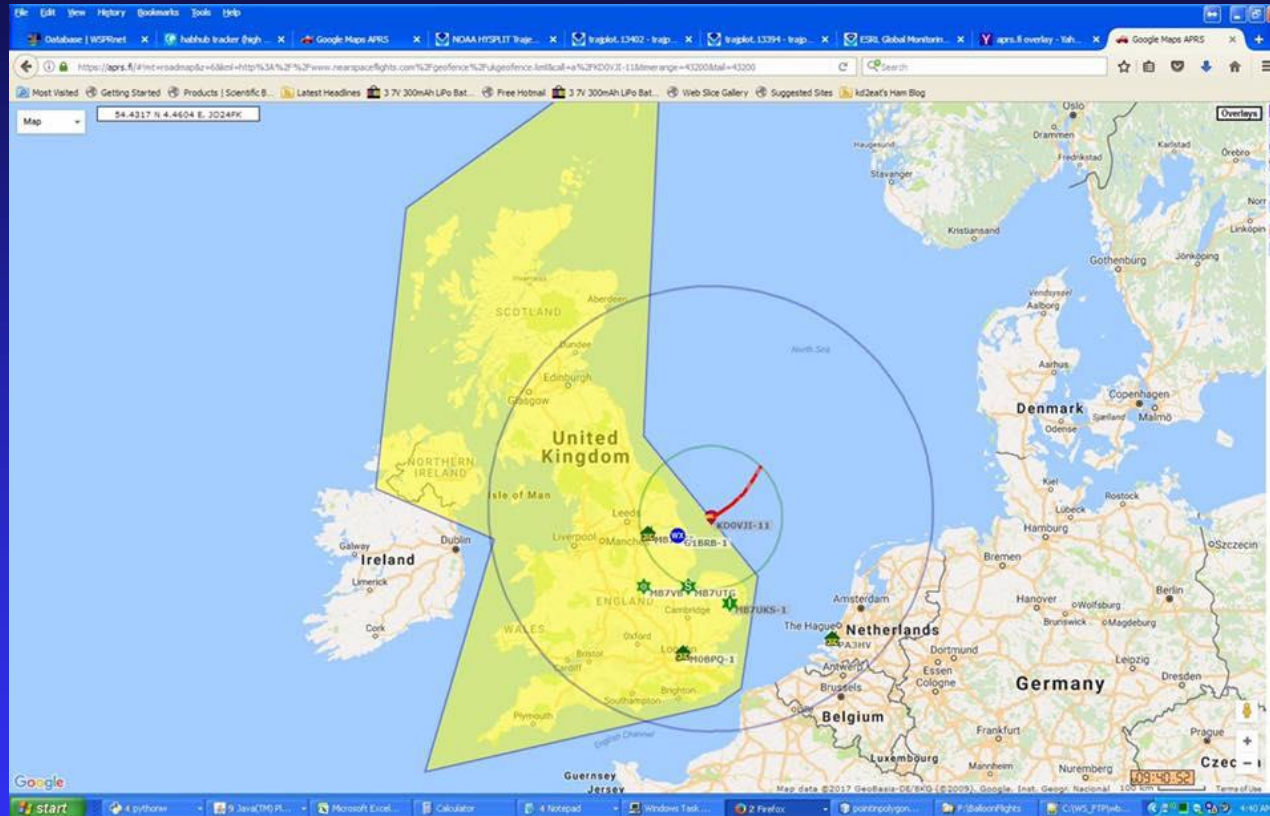
After six days floating at 27,000 feet my little party balloon ended up off the coast of Sweden having crossed the Atlantic Ocean in 32 hours.

# Pico Balloons



For an APRS tracker you have to automatically switch frequencies based on your location in the World.

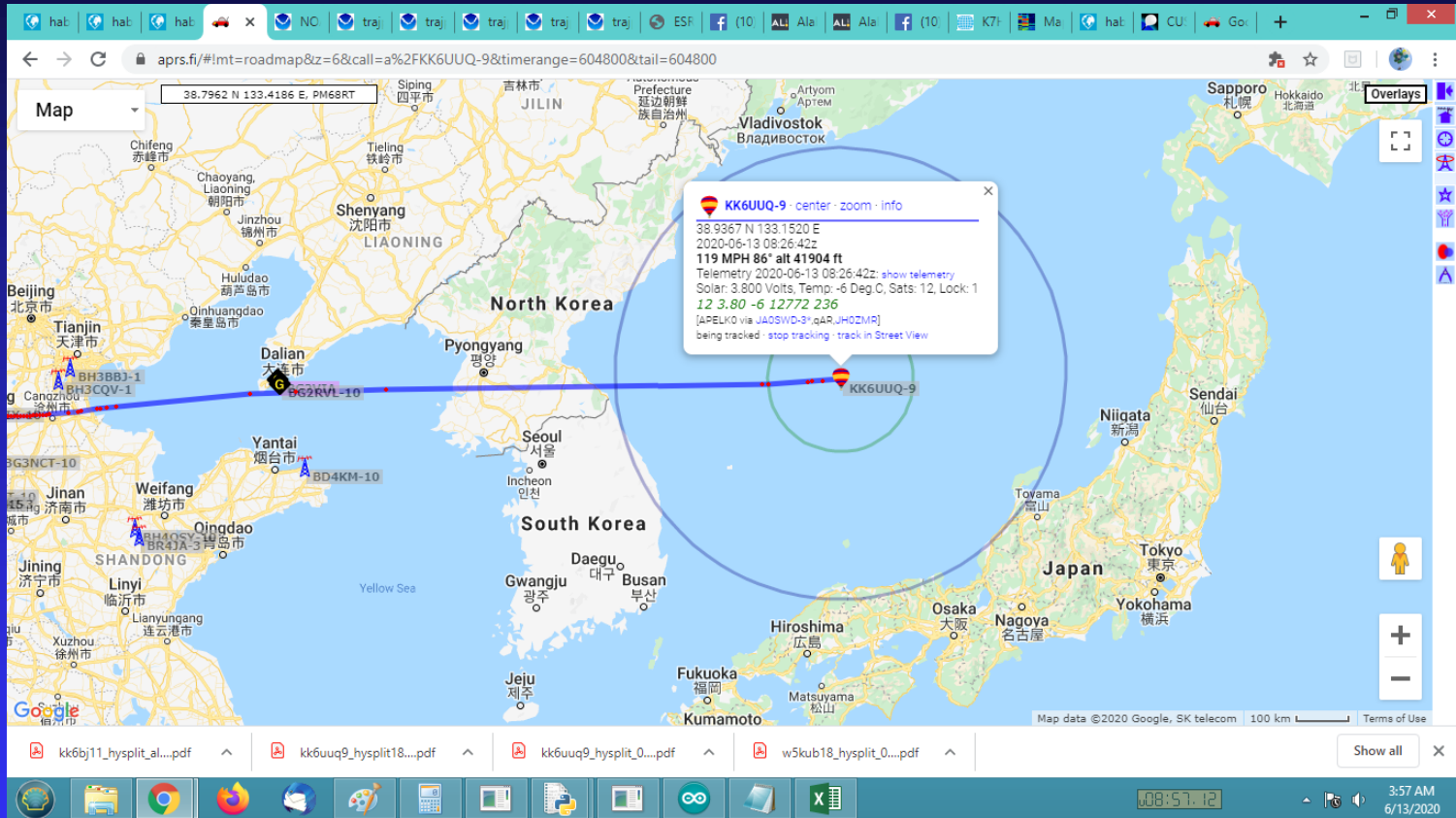
# Pico Balloons



There are several Do Not Transmit zones in the World: The UK, Yemen and North Korea are three of the most critical ones. An integer-based point-in-poly routine was written by KD2EAT and W7QQ.

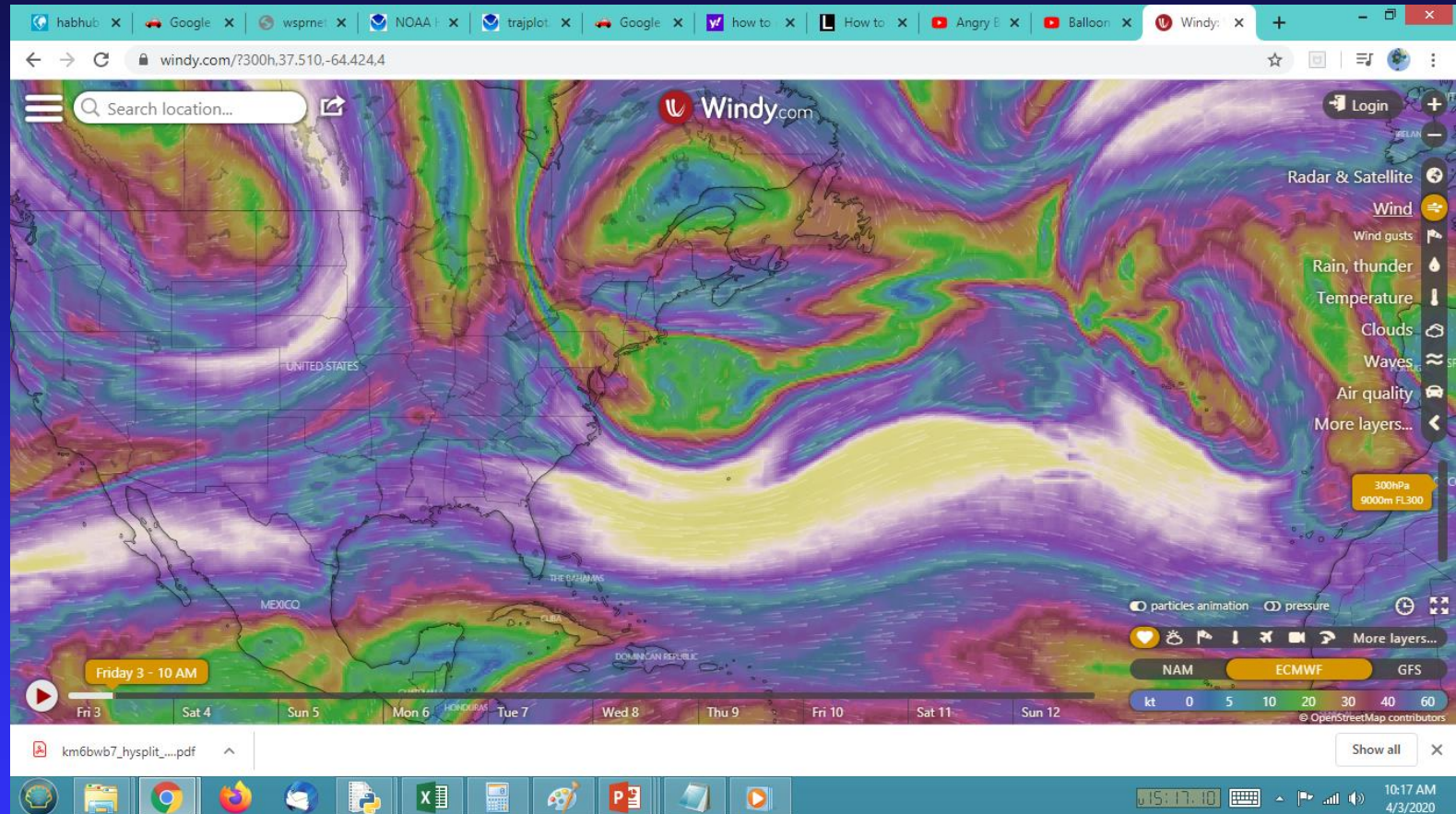


# Pico Balloons



The recent KK6UUQ-9 balloon flew directly over N. Korea but stopped transmitting over the country to prevent WWIII.

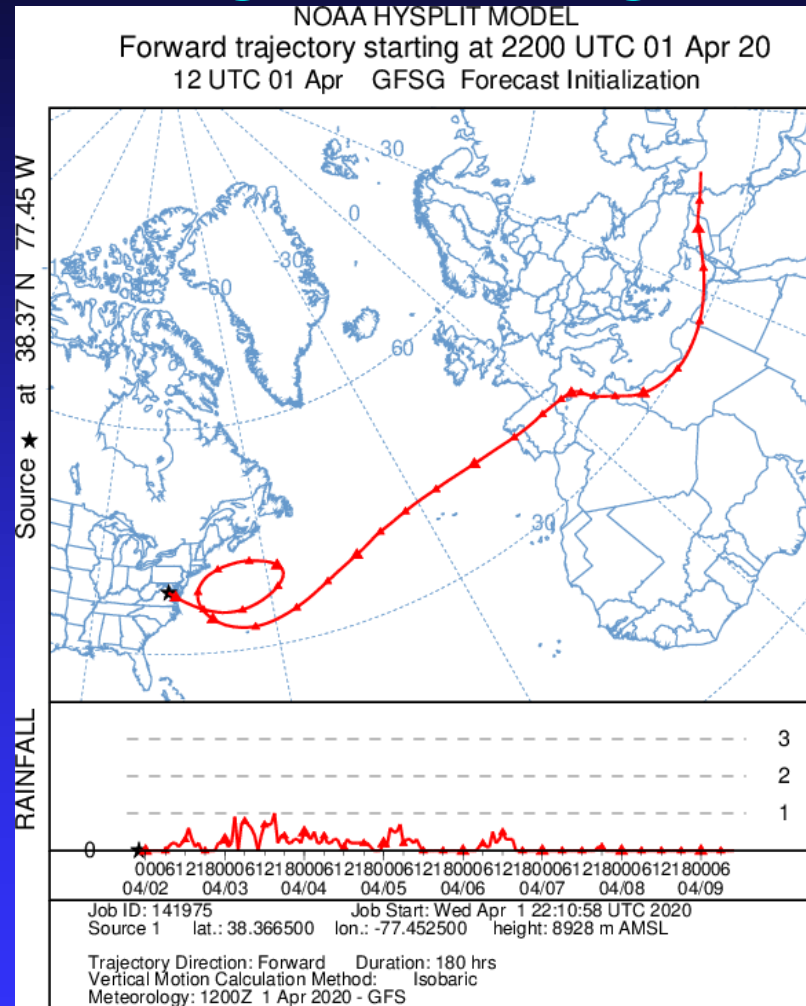
# Floats in the Jet Stream



Pico balloons float between 27000 to 45000 feet in the highest winds of the Jet stream. (Windytv.com)

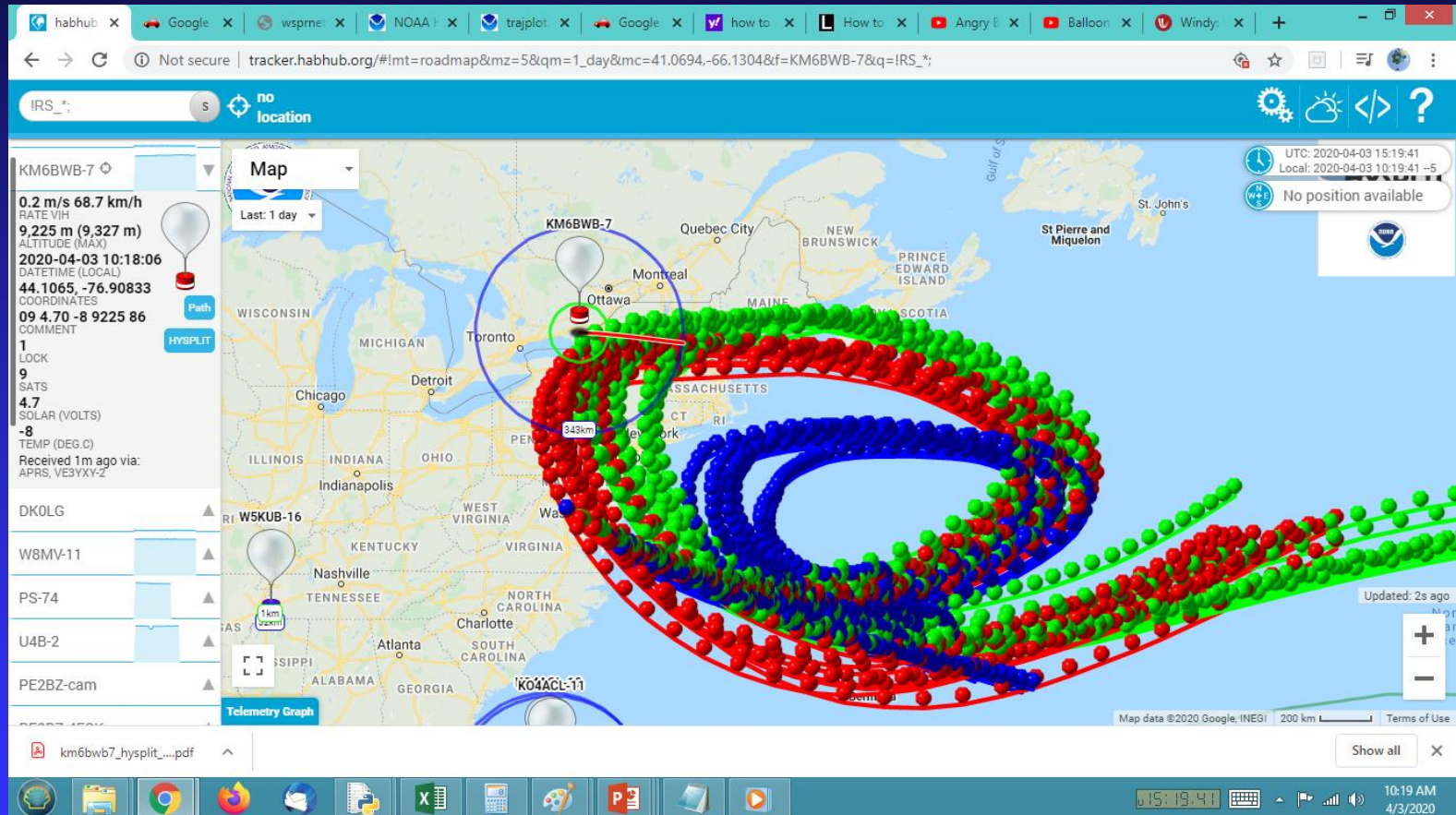


# Predicting the Flight Path



<https://ready.arl.noaa.gov/HYSPLIT.php>

# Actual Flight path



Tracker.habhub.org shows all balloons currently flying

# SBS-13 balloon



A new balloon by Scientific Balloon Solutions flies above 12 km to avoid most storm systems and can stay aloft long enough to circle the World.

# SBS-13 balloon



On its way to attempt a circumnavigation of the World.



# Over the Horizon telemetry

The screenshot displays the WSPRnet website interface. At the top, there are browser tabs for 'Map | WSPRnet', 'Google Maps APRS', 'habhub tracker (high altitude)', 'f (32) Bill Brown', and 'NOAA Solar Position Calculat...'. The address bar shows 'wspnet.org/drupal/wspnet/map'. The main header includes the WSPRnet logo and 'Weak Signal Propagation Reporter Network', along with navigation links for 'Chat', 'Activity', 'Map', 'Database', 'Stats', 'Forum', and 'Downloads'. A search bar and user account options are also present.

On the left side, there are several data panels:

- Frequencies:** Lists USB dial frequencies in MHz: 0.136, 0.4742, 1.8366, 3.5926, 5.2872, 7.0386, 10.1387, 14.0956, 18.1046, 21.0946, 24.9246, 28.1246, 50.293, 70.091, 144.489, 432.300, 1296.500.
- Spot Count:** Shows 379,950,331 total spots and 402,799 spots in the last 24 hours, with 10,520 spots in the last hour.
- Navigation:** Includes links for 'Add content', 'Chaos Tools AJAX Demo', and 'Forums'.
- Who's online:** States 'There are currently 90 users online.' and lists call signs such as wb8elk, k6pzb, bd4os, VK6HAX, K4BWUU, N3IZN, 5P1B, KG7LKI, W7SZ, PA1NL, G6NHU, DF4PV, oh6mqm, G0MRF, DK5HH, DK8FT, and 4Z4TJ.

The central 'Map' section features a world map with signal propagation paths shown as colored arcs connecting various call signs. A prominent path is shown from Australia (VK6JJ) to the United States (WB8ELK). Other call signs visible on the map include G4... and F59706. The map includes a 'Map | Satellite' toggle and a Google logo.

At the bottom, the Windows taskbar shows the 'start' button, several open applications (wspcapturetest\_20..., Python 3.4.2 Shell, Windows Task Manager, Map | WSPRnet - Goo..., 15 Notepad, Calculator, TeamViewer), and the system tray with the time '12:14 AM'.

Wrote a Python script to skim WSPR data from WSPRnet.org which reformats it to post to the vehicle tracker websites. Data received as far as Australia from the tiny HF wireless transmitter.

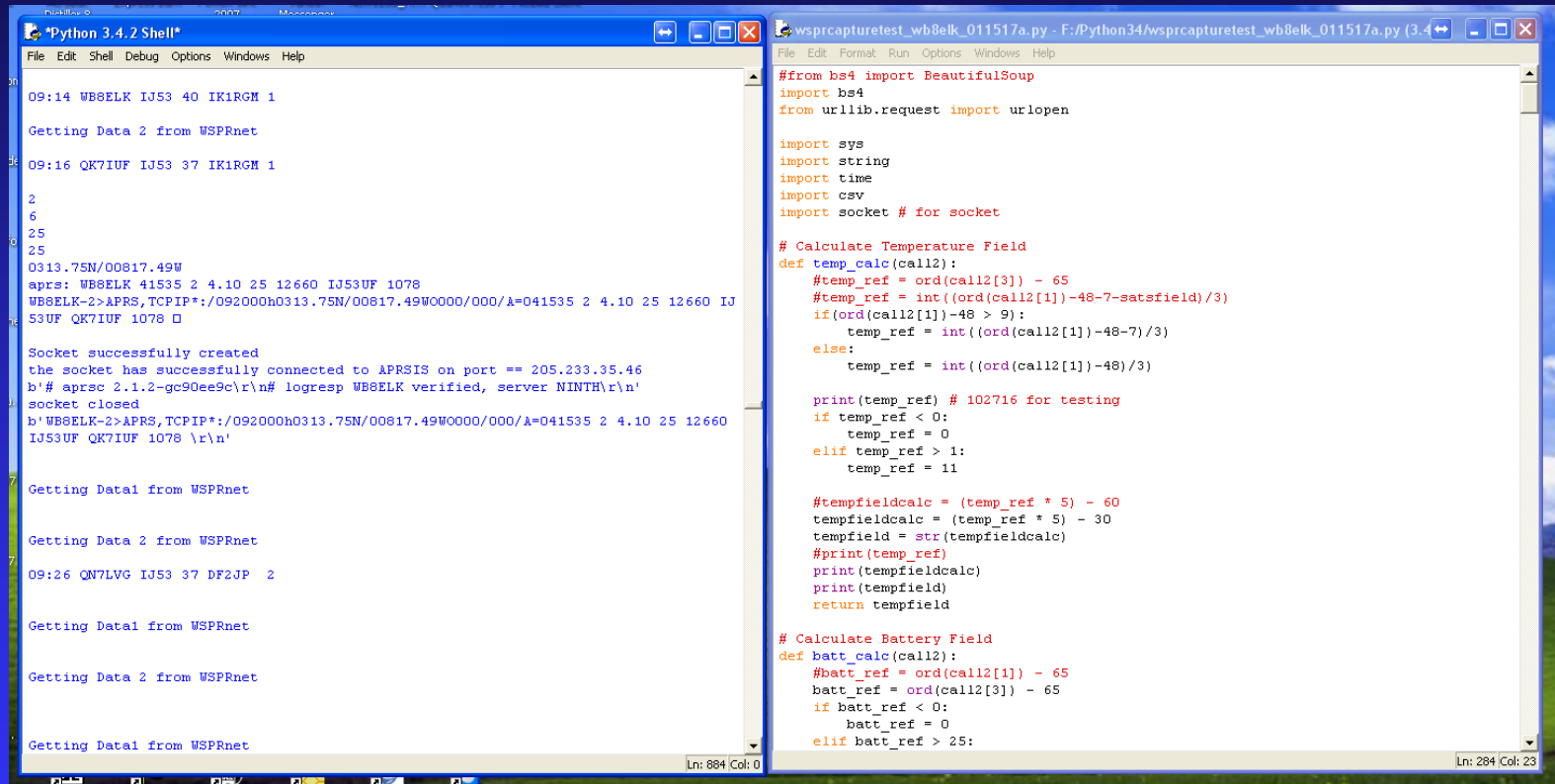
# Reception Report Database

The screenshot shows the WSPRnet website interface. At the top, there's a navigation bar with links for Activity, Map, Database, Stats, Forum, and Downloads. Below this is a 'User login' section with fields for Username and Password, and buttons for 'Create new account', 'Request new password', and 'Log in'. To the right of the login section is the 'Database' section, which includes a 'Specify query parameters' field and a '65 spots:' label. Below this is a table of reception reports with columns: Timestamp, Call, MHz, SNR, Drift, Grid, Pwr, Reporter, RGrid, km, and az. The table contains 65 rows of data, all starting with the call 'WB8ELK'. A search box with the value '06:48:41' is visible at the bottom right of the table area. The website footer includes a 'Who's online' section listing users like ZP9CTS, G4ZFQ, on7kb, and R2FBI.

Timestamp	Call	MHz	SNR	Drift	Grid	Pwr	Reporter	RGrid	km	az
2017-02-01 12:04	WB8ELK	14.097058	-26	0	IJ64	10	N4XWC	EM63nu	8792	304
2017-02-01 11:44	WB8ELK	14.097058	-28	0	IJ64	10	N4XWC	EM63nu	8792	304
2017-02-01 09:14	WB8ELK	14.097073	-28	0	IJ53	10	IKTRGM	JN35uc	4908	17
2017-02-01 09:14	WB8ELK	14.097065	-26	0	IJ53	10	PIBESA	JO22fd	5554	11
2017-02-01 09:04	WB8ELK	14.097069	-25	0	IJ53	10	DKBUG	JN49cm	5373	15
2017-02-01 08:44	WB8ELK	14.097072	-24	0	IJ53	10	IKTRGM	JN35uc	4908	17
2017-02-01 08:44	WB8ELK	14.097069	-26	0	IJ53	10	DKBUG	JN49cm	5373	15
2017-01-31 17:34	WB8ELK	14.097069	-25	0	IJ48	1000	LASJO	JP99gb	8161	11
2017-01-31 17:34	WB8ELK	14.097084	-18	0	IJ48	1000	OY6FRA	IP62oa	7075	2
2017-01-31 17:34	WB8ELK	14.097066	-25	0	IJ48	1000	DLDLU	JN49cm	5968	15
2017-01-31 17:24	WB8ELK	14.097067	-26	0	IJ48	10	DLDLU	JN49cm	5968	15
2017-01-31 17:24	WB8ELK	14.097084	-22	-1	IJ48	10	OY6FRA	IP62oa	7075	2
2017-01-31 17:14	WB8ELK	14.097084	-20	-2	IJ48	10	OY6FRA	IP62oa	7075	2
2017-01-31 16:14	WB8ELK	14.097070	-26	0	IJ48	10	DF6MK	JN68ik	6009	19
2017-01-31 13:34	WB8ELK	14.097052	-27	0	IJ38	10	N4XWC	EM63nu	8618	305
2017-01-31 13:24	WB8ELK	14.097052	-23	0	IJ38	10	N4XWC	EM63nu	8618	305
2017-01-31 13:14	WB8ELK	14.097070	-28	0	IJ38	10	N2NC	FN20ve	7722	314
2017-01-31 13:14	WB8ELK	14.097053	-25	0	IJ38	10	N4XWC	EM63nu	8618	305
2017-01-31 13:04	WB8ELK	14.097053	-23	0	IJ38	10	N4XWC	EM63nu	8618	305
2017-01-31 12:44	WB8ELK	14.097052	-22	0	IJ38	10	N4XWC	EM63nu	8618	305
2017-01-31 12:34	WB8ELK	14.097053	-22	0	IJ38	10	N4XWC	EM63nu	8618	305
2017-01-31 12:14	WB8ELK	14.097052	-26	0	IJ38	10	N4XWC	EM63nu	8618	305
2017-01-31 12:04	WB8ELK	14.097053	-21	0	IJ38	10	N4XWC	EM63nu	8618	305
2017-01-31 08:54	WB8ELK	14.097067	-26	0	IJ37	10	DLDLU	JN49cm	6136	17
2017-01-30 18:14	WB8ELK	14.097084	-24	0	IJ17	10	OY6FRA	IP62oa	7229	5
2017-01-30 18:14	WB8ELK	14.097067	-19	0	IJ17	10	F5KLF	JN24ko	5674	20
2017-01-30 18:14	WB8ELK	14.097083	-27	0	IJ17	10	PIBESA	JO22fd	6406	15
2017-01-30 18:14	WB8ELK	14.097058	-23	0	IJ17	10	PI4THT	JO32kf	6489	17
2017-01-30 18:04	WB8ELK	14.097084	-20	0	IJ17	10	OY6FRA	IP62oa	7229	5
2017-01-30 16:44	WB8ELK	14.097072	-25	0	IJ17	10	ON7KO	JO21ce	6302	16
2017-01-30 16:44	WB8ELK	14.097068	-24	0	IJ17	10	F5KLF	JN24ko	5674	20
2017-01-30 16:34	WB8ELK	14.097055	-25	0	IJ17	10	DLDLU	JN49cm	5968	15

Decoding software used by hundreds of ground stations World-wide uploads reception reports to a central database.

# Skimming data with Python



```
Python 3.4.2 Shell
File Edit Shell Debug Options Windows Help
09:14 WB8ELK IJ53 40 IK1RGM 1
Getting Data 2 from WSPRnet
09:16 QK7IUF IJ53 37 IK1RGM 1
2
6
25
25
0313.75N/00817.49W
aprs: WB8ELK 41535 2 4.10 25 12660 IJ53UF 1078
WB8ELK-2>APRS,TCPIP*:/092000h0313.75N/00817.49W0000/000/A=041535 2 4.10 25 12660 IJ
53UF QK7IUF 1078 □
Socket successfully created
the socket has successfully connected to APRSIS on port == 205.233.35.46
b'# aprsc 2.1.2-gc90ee9c\r\n# logresp WB8ELK verified, server NINTH\r\n'
socket closed
b'WB8ELK-2>APRS,TCPIP*:/092000h0313.75N/00817.49W0000/000/A=041535 2 4.10 25 12660
IJ53UF QK7IUF 1078 \r\n'
Getting Data1 from WSPRnet
Getting Data 2 from WSPRnet
09:26 QN7LVG IJ53 37 DF2JP 2
Getting Data1 from WSPRnet
Getting Data 2 from WSPRnet
Getting Data1 from WSPRnet

Ln: 884 Col: 0

wsprcapturetest_wb8elk_011517a.py - F:/Python34/wsprcapturetest_wb8elk_011517a.py (3.4)
File Edit Format Run Options Windows Help
#from bs4 import BeautifulSoup
import bs4
from urllib.request import urlopen

import sys
import string
import time
import csv
import socket # for socket

# Calculate Temperature Field
def temp_calc(call2):
    #temp_ref = ord(call2[3]) - 65
    #temp_ref = int((ord(call2[1])-48-7-satsfield)/3)
    if(ord(call2[1])-48 > 9):
        temp_ref = int((ord(call2[1])-48-7)/3)
    else:
        temp_ref = int((ord(call2[1])-48)/3)

    print(temp_ref) # 102716 for testing
    if temp_ref < 0:
        temp_ref = 0
    elif temp_ref > 1:
        temp_ref = 11

    #tempfieldcalc = (temp_ref * 5) - 60
    tempfieldcalc = (temp_ref * 5) - 30
    tempfield = str(tempfieldcalc)
    #print(temp_ref)
    print(tempfieldcalc)
    print(tempfield)
    return tempfield

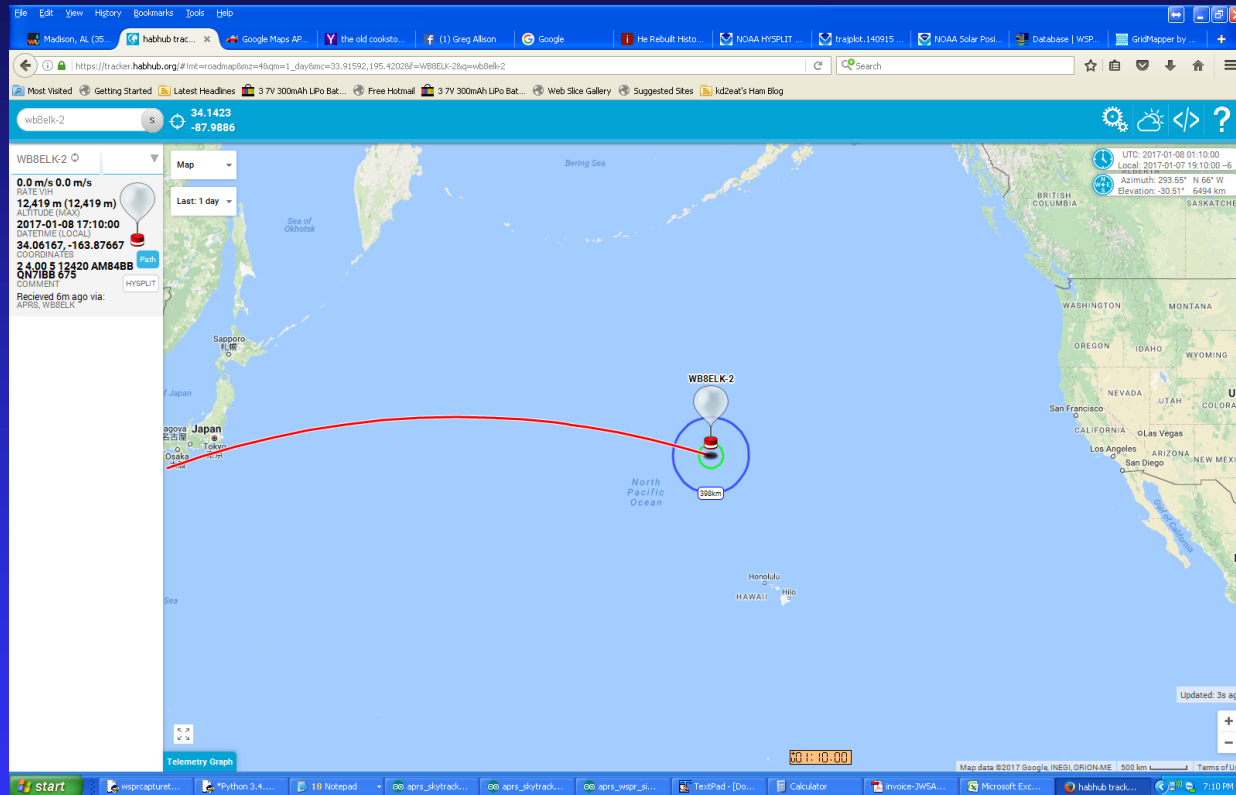
# Calculate Battery Field
def batt_calc(call2):
    #batt_ref = ord(call2[1]) - 65
    batt_ref = ord(call2[3]) - 65
    if batt_ref < 0:
        batt_ref = 0
    elif batt_ref > 25:

Ln: 284 Col: 23
```

Python script skims the database of the raw position reports coming in from remote ground stations and sends it to a vehicle-tracking website for a position map display.

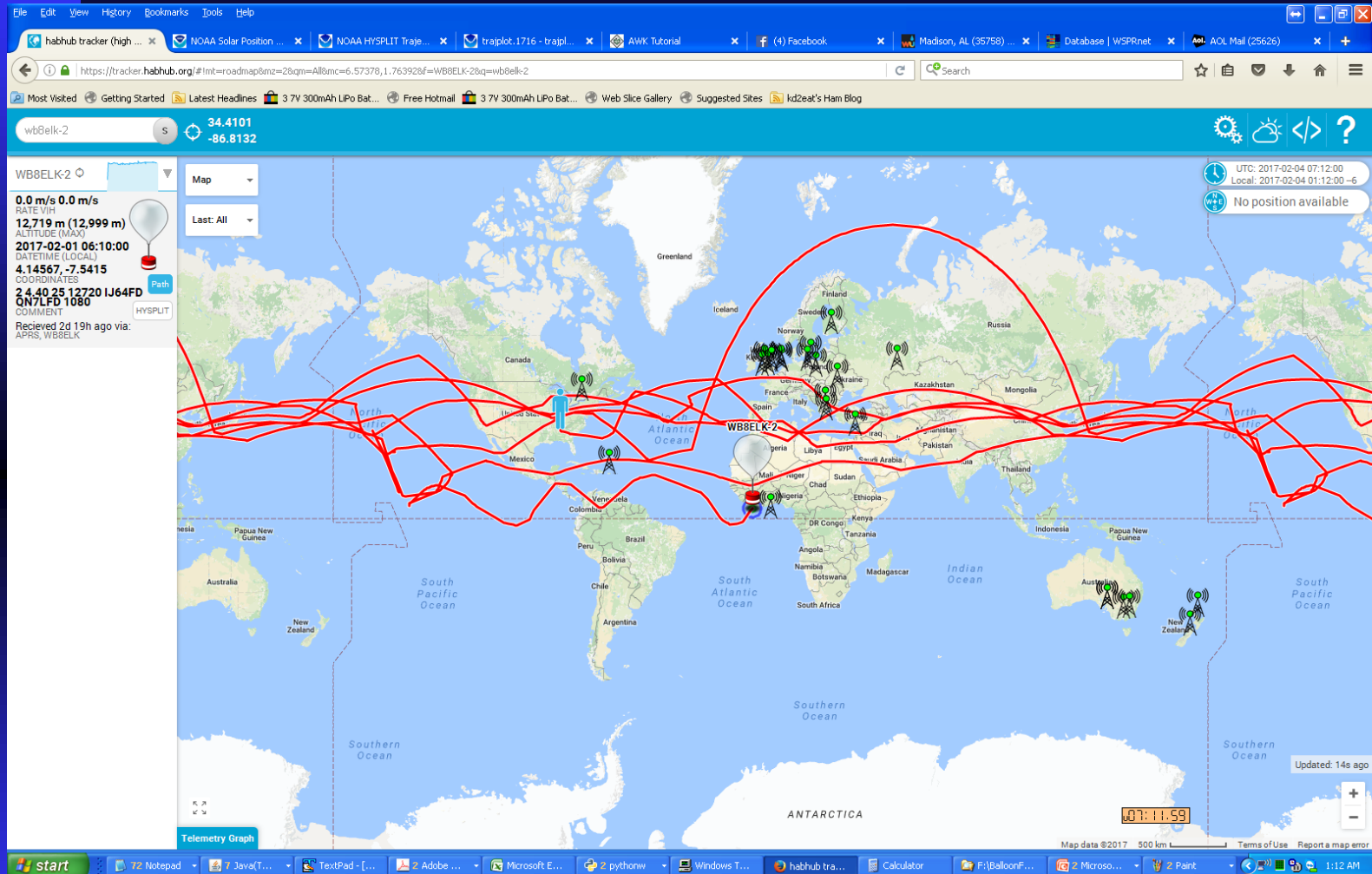


# Balloon Tracking web map



Final result of reformatted raw WSPR data as displayed on the TRACKER. HABHUB.ORG map. Also shows up on APRS.FI

# Around the World



My Skytracker 20m WSPR flight went around the World over 6 times after flying at 40,000 feet for 75 days.

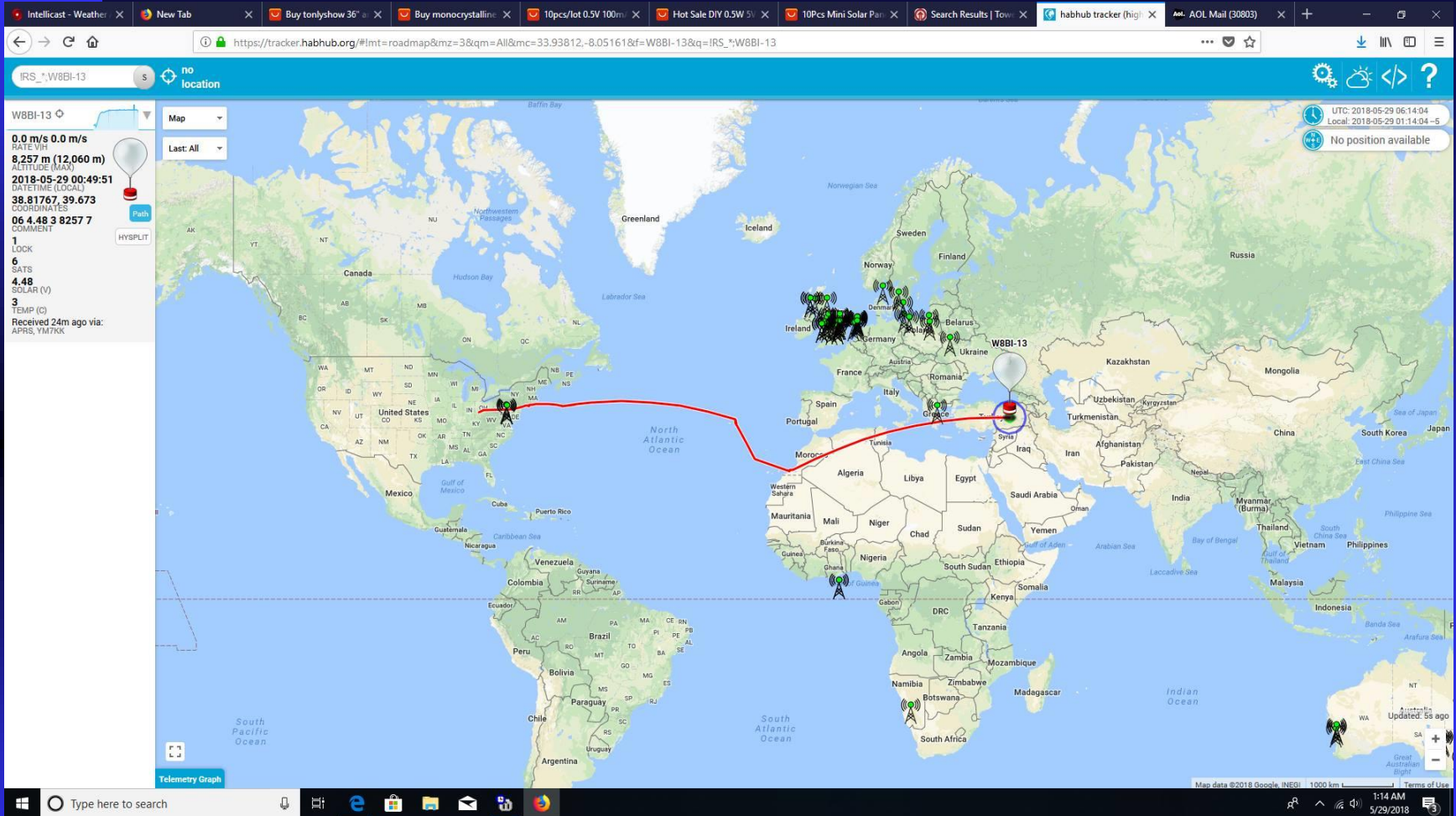
# Dayton Hamvention 2018 Pico balloon flight



The Hamvention Hexbeam snags the W8BI-13 pico balloon



# Dayton Hamvention 2018 Pico balloon flight



11 day flight from Dayton Hamvention to Turkey

# Youth On The Air



Audrey KM4BUN and Jack KM4ZIA are quite active in High Altitude Ballooning, both regular latex flights and long duration Pico Flights, they plan to launch two WSPR balloons for GPSL2020.



# YOTA Activities



Audrey KM4BUN produced a video she presented to the YOTA (Youth On The Air) group about Pico Balloons.



## Bev WB4ELK prepares a pico balloon for liftoff



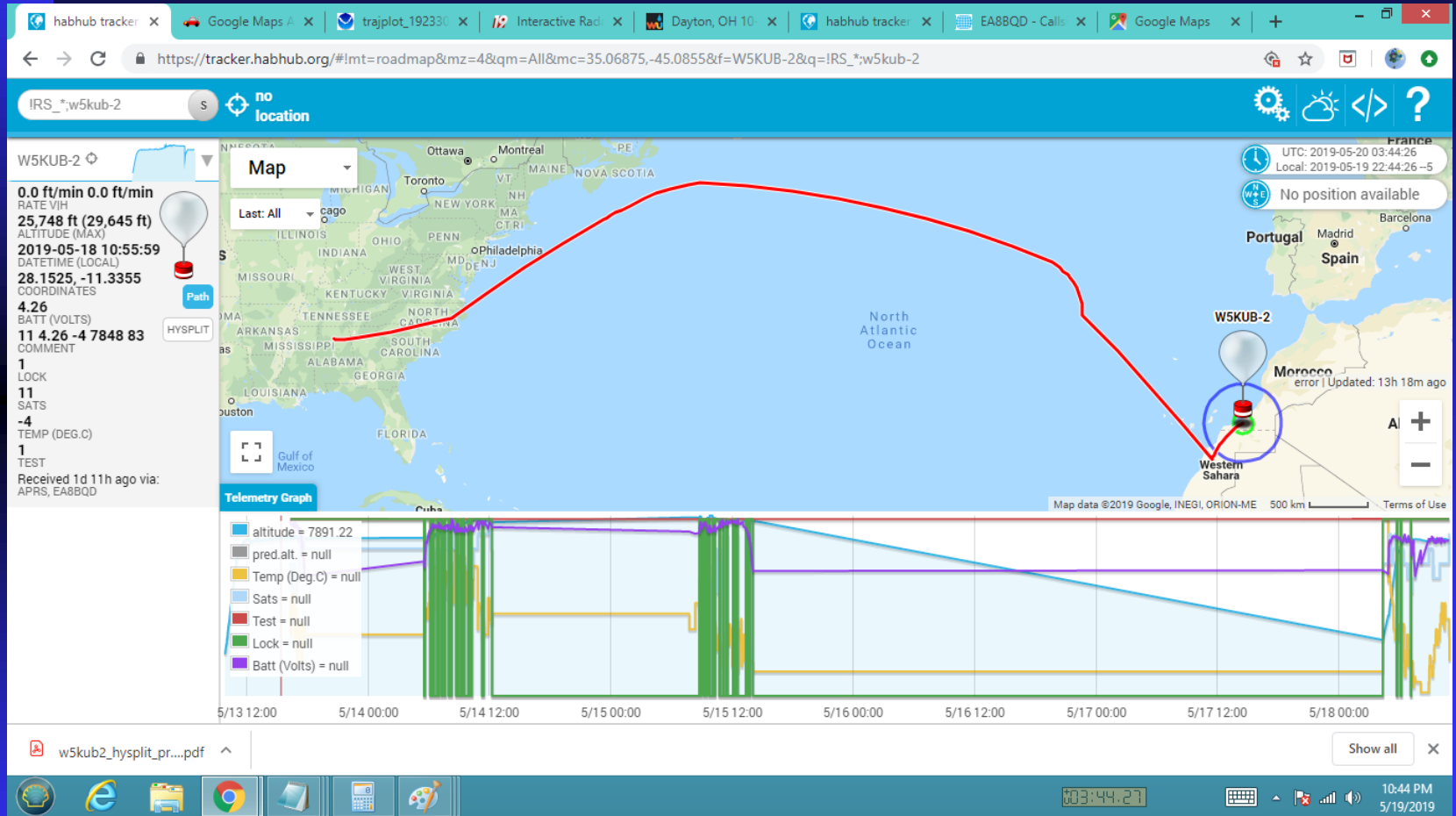
West Point Middle school pico launch – Cullman AL

# West Point Middle school pico balloon launch



West Point Middle school pico launch – Cullman AL

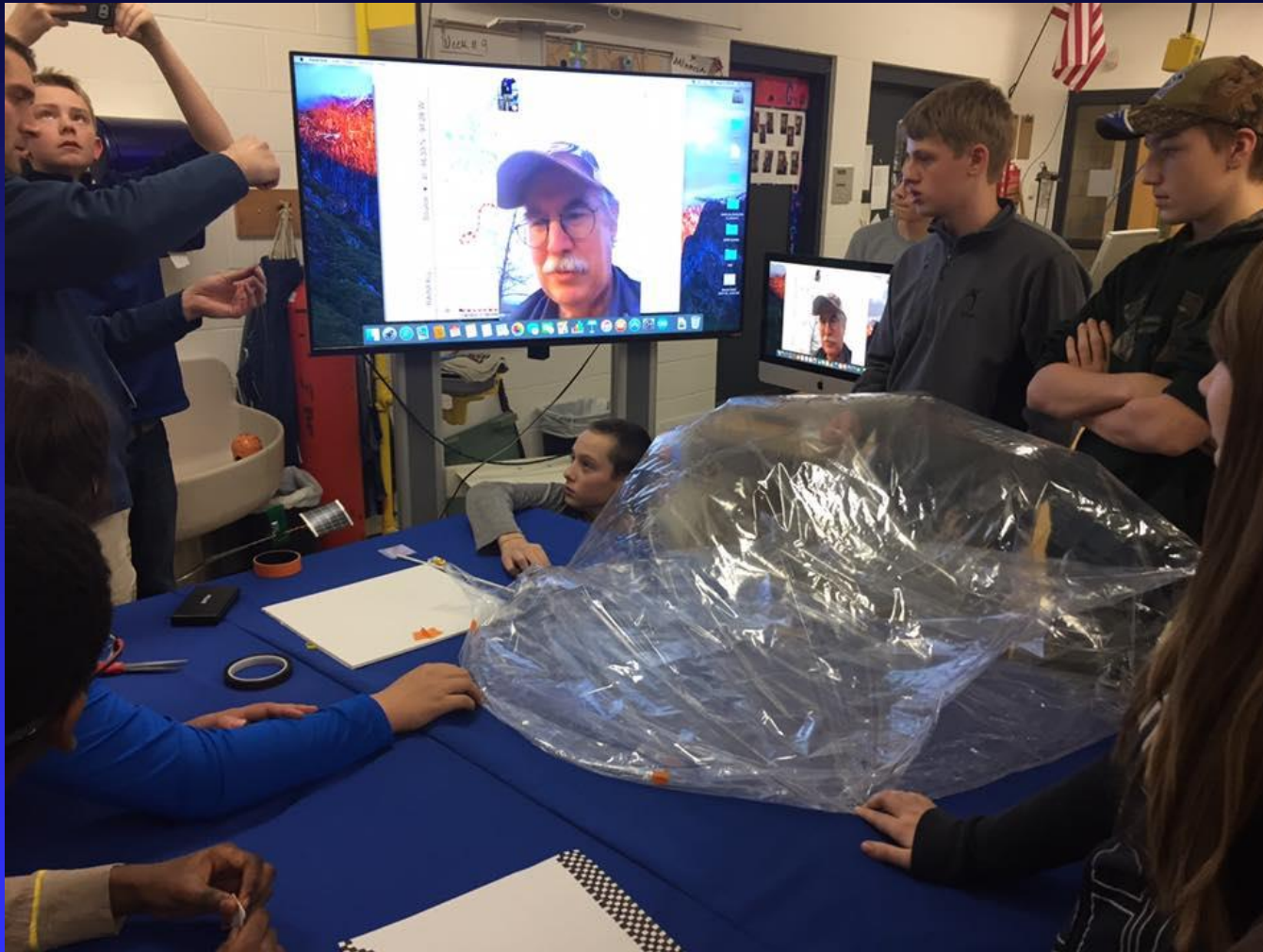
# West Point Middle School – Mylar party balloon to Morocco



W5KUB-2 showing predicted flight path



# Around the World



Students at Forestview Middle School in Baxter MN flew the very first middle school balloon to circumnavigate the World.  
KD0VJI-11

# Around the World



UC San Diego students have flown their KK6PNN-5 balloon around the World 6 times and has been flying for 3 months.

# Great Plains Superlaunch 2016



9 Latex weather balloons launched. 3 Mylar Pico balloons.



# Great Plains Superlaunch



7 balloons in the air at once during group launch.



# Great Plains Superlaunch 2020



10 Pico balloons and 5 Latex balloons launched live via Zoom streaming video. [SUPERLAUNCH.ORG](http://SUPERLAUNCH.ORG)

For more info contact:

[WB8ELK@gmail.com](mailto:WB8ELK@gmail.com)



The Future of Amateur Radio Ballooning?.



**Q&A**