Radiosonde Tracking

ラジオソンデ追跡

A presentation to TIARA
February 20th, 2022

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http://www.jh1hnb.jp/

Genesis

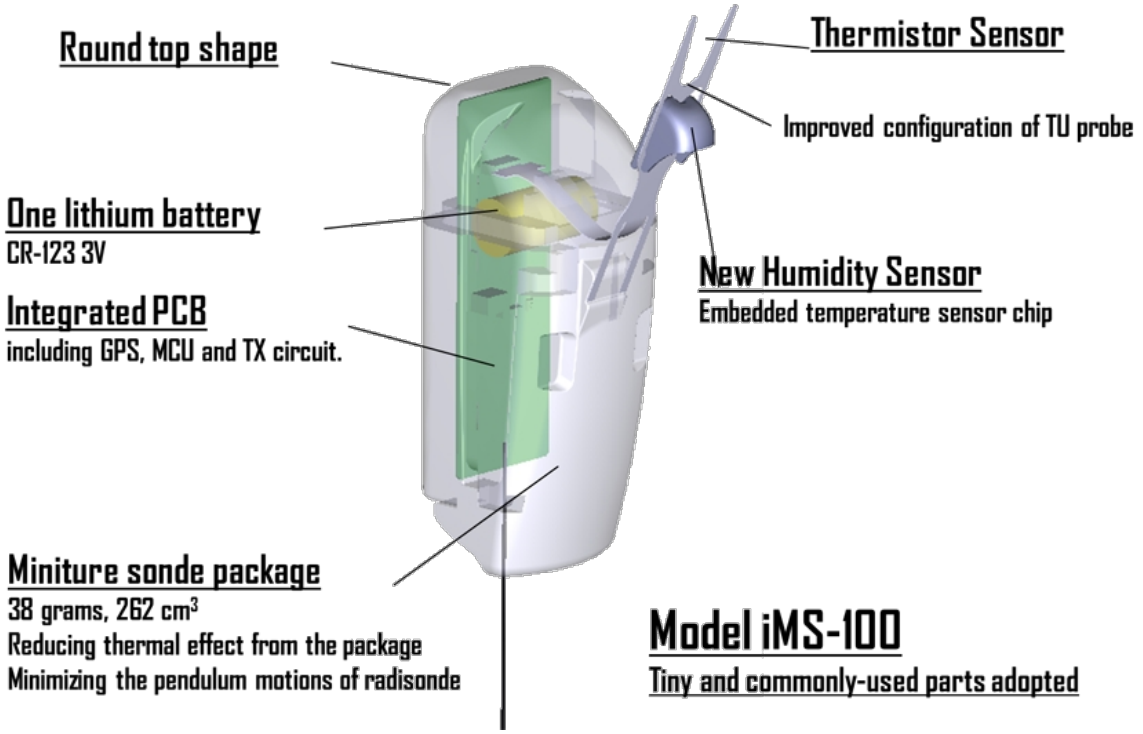
Jim presented his TinyGS tracking device in an earlier TIARA meeting. Under his guidance, I tried this, and was later contacted along with Jim and others in the TinyGS community with a request to set up weather balloon tracking stations in Japan.

Hiroshi Iwamoto (JH4XSY) set up the first site in Japan, and shortly thereafter, I set up the second.

https://en.wikipedia.org/wiki/Radiosonde

What is Radiosonde

“A radiosonde is a battery-powered telemetry instrument carried into the atmosphere usually by a weather balloon that measures various atmospheric parameters and transmits them by radio to a ground receiver.”



https://en.wikipedia.org/wiki/Radiosonde

Early History

In 1924, Colonel William Blaire in the U.S. Signal Corps did the first primitive experiments with weather measurements from balloon, making use of the temperature dependence of radio circuits. The first true radiosonde that sent precise encoded telemetry from weather sensors was invented in France by Robert Bureau. Bureau coined the name "radiosonde" and flew the first instrument on January 7, 1929.Developed independently a year later, Pavel Molchanov flew a radiosonde on January 30, 1930. Molchanov's design became a popular standard because of its simplicity and because it converted sensor readings to Morse code, making it easy to use without special equipment or training.

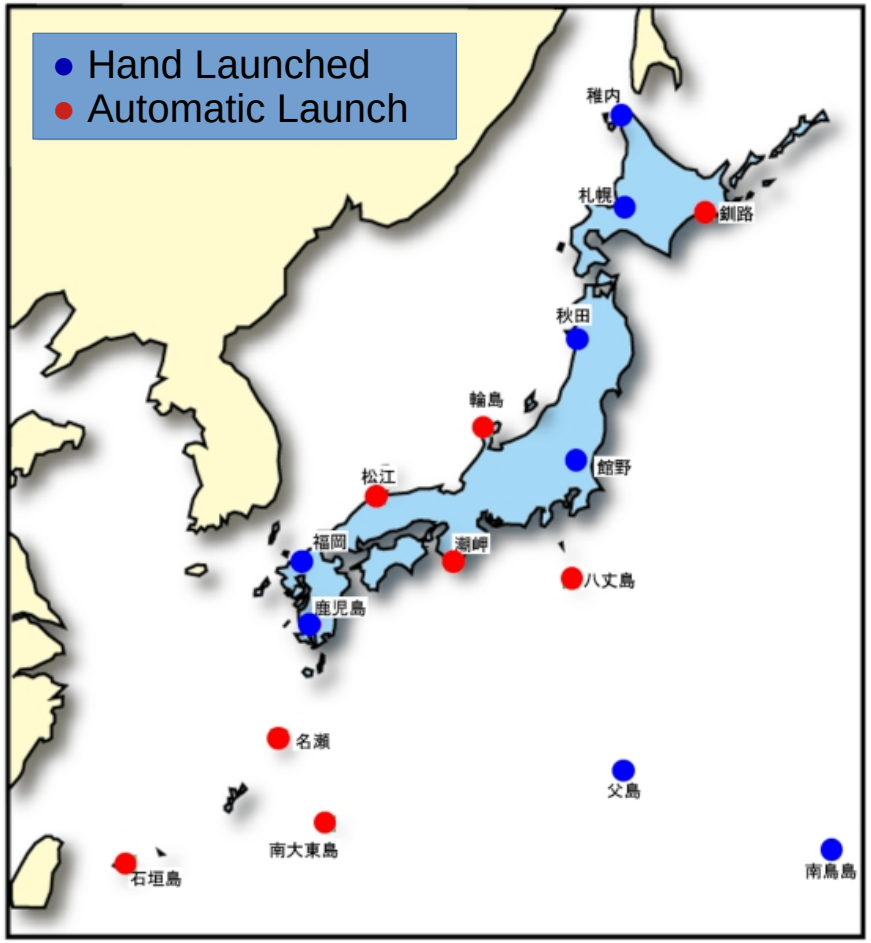
https://en.wikipedia.org/wiki/Radiosonde

Japan Launches

18 meteorological observatories and weather stations, the Air Self-Defense Force, the Ground Self-Defense Force, universities and other research institutes, and the Japan Weather Association conduct observations. Meteorological observatories and weather stations usually fly twice a day (8:30 a.m. and 8:30 p.m.). When a typhoon is approaching, they may fly up to four times a day. The Japan Coast Guard flies them from ships, but they can also be dropped from aircraft.

https://ja.wikipedia.org/wiki/ラジオゾンデ

Japan Meteorological Observatory Launch Sites



Name, Location (North to South)	Latitude	Longitude
Wakkanai, Hokkaido	45°24.9′	141°40.7′
Sapporo, Hokkaido	43°03.6′	141°19.7′
Kushiro, Hokkaido	42°57.2′	144°26.3″
Akita, Akita	39°43.1′	140°06.0′
Wajimai, Ishikawa	37°23.5′	136°53.7′
Tateno, Ibaraki	36°03.5′	140°07.5′
Hachijojima, Tokyo	33°07.3′	139°46.7′
Matsue, Shimane	35°27.5′	133°04.0′
Shionomisaki, Wakayama	33°27.1′	135°45.7′
Fukuoka, Fukuoka	33°35.0′	130°23.0′
Kagoshima, Kagoshima	31°33.3′	130°32.9′
Naze, Kagoshima	28°23.6′	129°33.2′
Ishigaki, Okinawa	24°20.2′	124°09.8′
Minami Daito, Okinawa	25°49.8′	131°13.7′
Chichijima, Tokyo	27°05.7′	142°11.1′
Minamitorishima, Tokyo	24°17.4′	153°59.0′
Showa Station, Antarctica [not shown on map :-)]	-69°00.3′	39°34.7

https://www.jma-net.go.jp/kousou/obs_second_div/sonde/sonde04.html
https://www.jma.go.jp/jma/kishou/know/upper/kaisetsu.html

Sample Devices

iMS-100, RS-11G, and RS41-SG

On top are temperature and humidity guages.

Internal: GPS, transmitter, signal conversion board, battery, etc.

https://www.jma.go.jp/jma/kishou/know/upper/kaisetsu.html

Observed Launches

Sites:

Matsue, Shionomisaki, Tateno, non-observatory

Frequencies:

404.0-404.5,405.3,405.6,405.7MHz

Models:

DFM17, iMS-100, LMS6, RS41, RS41-SG

Setup:

A: Raspberry Pi 3 B+, 1000 yen used no name DVB-T+FM+DAB 820T2

B: TTGO LoRa32 V2.1-1.6 Version 433

Software: radiosonde auto rx

Recommended

- Widest mode support
- Raspi 3 or 4 + RTL-SDR + Antenna
- Load software and go
- RTL-SDR should have temperature compensated oscillator (TCXO)
- WiFi or Ethernet

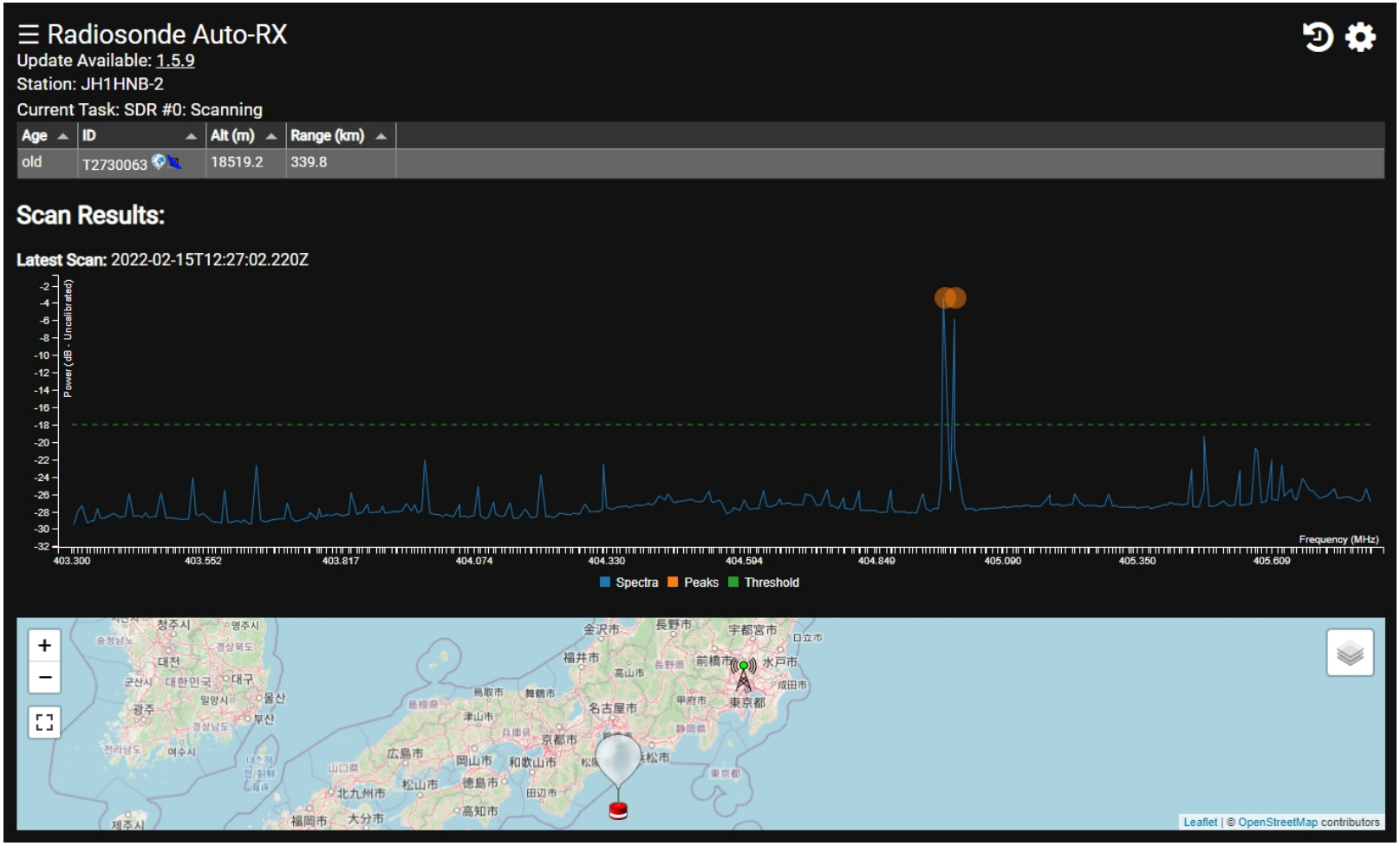
https://github.com/projecthorus/radiosonde_auto_rx

Radiosonde Support Matrix

Manufacturer	Model	Position	Temperature	Humidity	Pressure	XDATA
Vaisala	RS92-SGP/NGP	✔	✔	✔	✔	✔
Vaisala	RS41-SG/SGP/SGM	✔	✔	✔	✔ (for -SGP)	✔
Graw	DFM06/09/17	✔	✔	✘	✘	✘
Meteomodem	M10	✔	✔	✔	Not Sent	✘
Meteomodem	M20	✔	✔	✔	✔ (For some models)	✘
Intermet Systems	iMet-4	✔	✔	✔	Not Sent	✘
Intermet Systems	iMet-54	✔	✔	✔	Not Sent	✘
Lockheed Martin	LMS6-400/1680	✔	✘	✘	✘	Not Sent
Meisei	iMS-100	✔	✘	✘	✘	Not Sent
Meteo-Radiy	MRZ-H1 (400 MHz)	✔	✔	✔	✘	Not Sent

rdzTTGOSonde

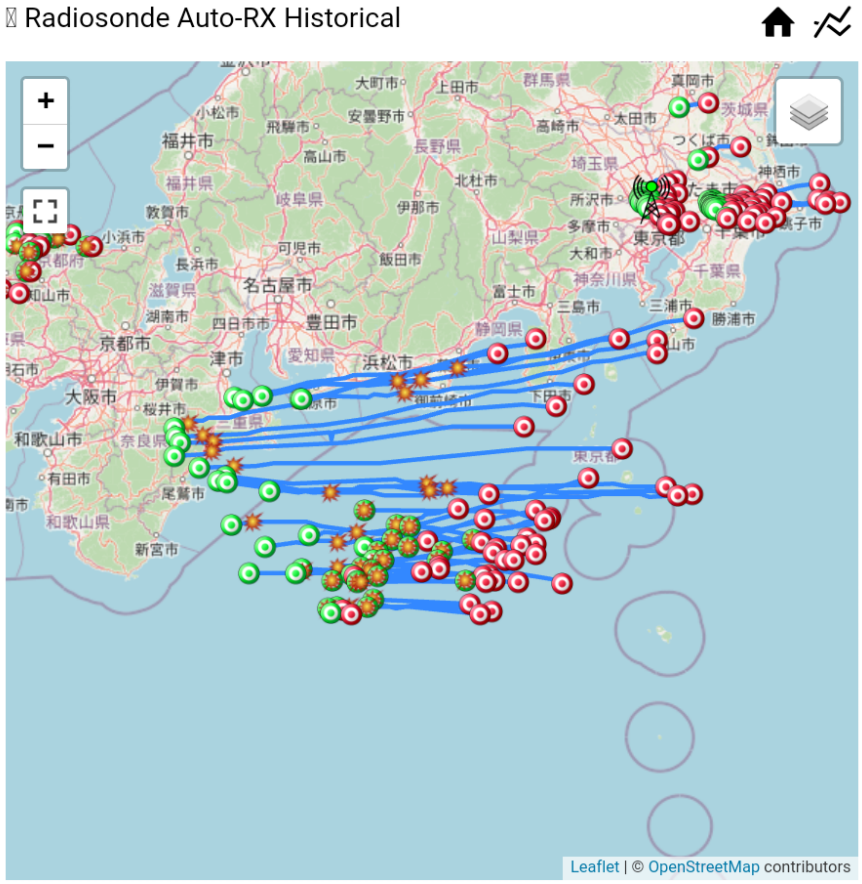
Software: Spectrum Scan



via home lan interface into device

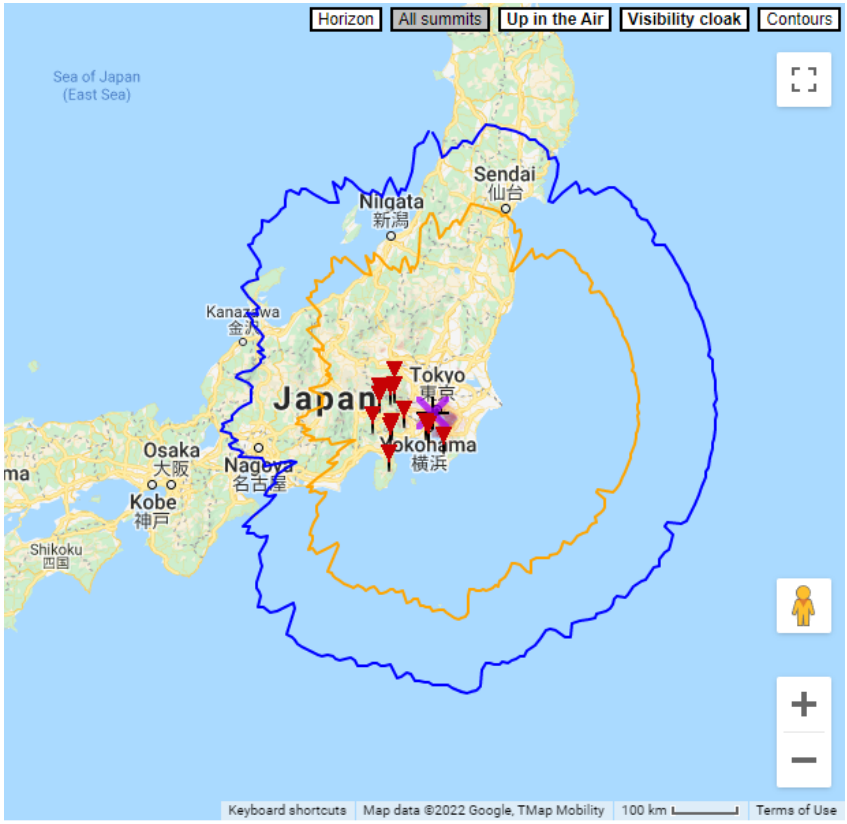
Sample Screen Log & Paths

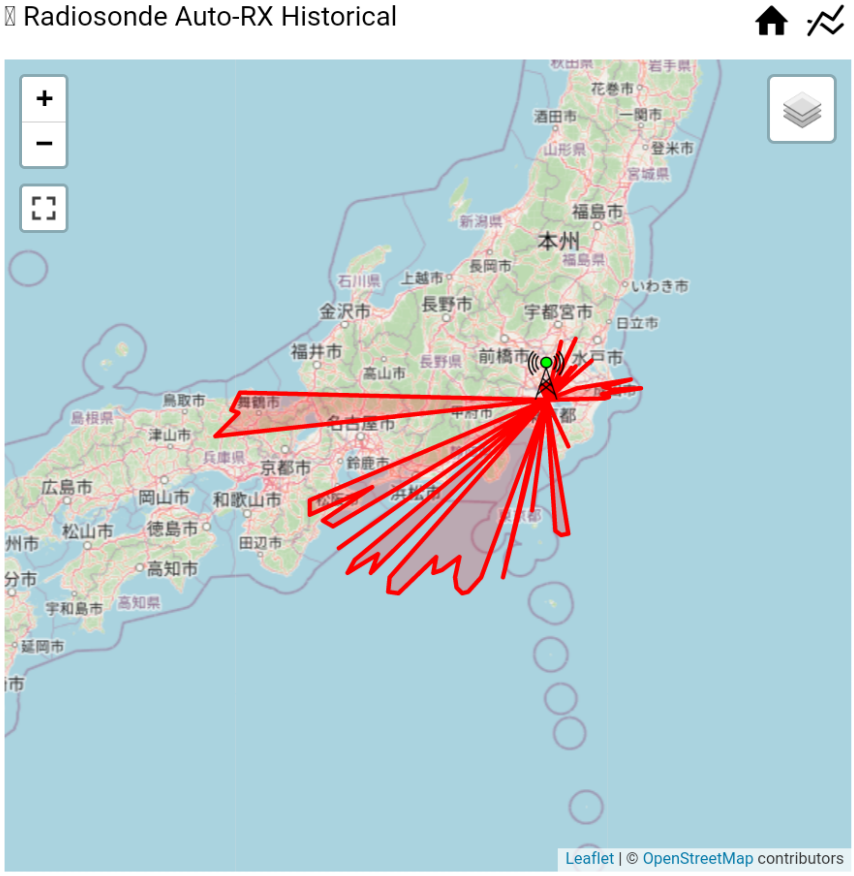
Date	Type	Serial	Count	Last H	Last R	Max R
2022-01-28T12:17:34Z	RS41	T2720737	49	14314 m	340 km	345 km
2022-01-28T12:58:32Z	RS41	T4030229	52	19774 m	423 km	427 km
2022-01-28T14:03:18Z	DFM17	20062777	478	7024 m	254 km	273 km
2022-01-28T16:27:53Z	DFM17	20062597	2668	5351 m	240 km	354 km
2022-01-28T19:53:36Z	DFM17	20062773	879	5083 m	233 km	265 km
2022-01-28T22:49:59Z	DFM17	21039322	1402	4404 m	212 km	277 km
2022-01-29T01:12:33Z	RS41	T3140142	52	16453 m	380 km	384 km
2022-01-29T01:19:58Z	RS41	T2720767	241	9791 m	262 km	277 km
2022-01-29T01:31:29Z	LMS6-403	8178073	2282	3923 m	215 km	320 km
2022-01-29T04:26:01Z	LMS6-403	8179725	4921	2942 m	187 km	340 km
2022-01-29T06:07:17Z	iMS-100	IMS100-11...	865	8535 m	119 km	119 km
2022-01-29T07:29:18Z	LMS6-403	8142745	3678	3819 m	187 km	344 km
2022-01-29T10:26:59Z	LMS6-403	8179797	3728	2502 m	180 km	339 km
2022-01-29T12:09:26Z	RS41	T2730054	787	7762 m	278 km	342 km
2022-01-29T12:42:37Z	RS41	T4050098	228	18606 m	395 km	407 km
2022-01-29T13:17:41Z	DFM17	21039614	3221	1727 m	154 km	352 km
2022-01-29T15:08:09Z	iMS-100	IMS100-11...	543	6987 m	90 km	90 km
2022-01-29T16:12:18Z	DFM17	21039143	3072	1685 m	163 km	363 km



via home lan interface into device

Theoretical Range @ 5000m, 10000m vs. Coverage, Ebisu condo 9F





Left: http://www.heywhatsthat.com/
new panorama -> input long, lat and title, [submit request] -> up in the air -> input altitudes
Right: via home lan interface into device

radiosonde autorx

Downloadable Logs

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	timestamp	serial	frame	lat	lon	alt	vel_v	vel_h	heading	temp	humidity	pressure	type	freq_mhz	snr	f_error_hz	sats	batt_v	burst_timer	aux_data
2	2022-01-28T12:17:50.000Z	T2720737	4305	33.26612	137.28816	15374.2	-5.1	58.5	89	-273	-1	-1	RS41	405.6	7.2	-7687	8	2.6	-1	-1
3	2022-01-28T12:17:51.000Z	T2720737	4306	33.26612	137.28879	15369.1	-5.4	58.7	89.4	-273	-1	-1	RS41	405.6	8.9	-7687	10	2.6	-1	-1
4	2022-01-28T12:17:52.000Z	T2720737	4307	33.26613	137.28942	15363.7	-5.2	59.5	89.5	-273	-1	-1	RS41	405.6	8.9	-7687	10	2.6	-1	-1
5	2022-01-28T12:17:53.000Z	T2720737	4308	33.26613	137.29006	15358.5	-5.3	59.3	89.8	-273	-1	-1	RS41	405.6	7.9	-7687	10	2.7	-1	-1
6	2022-01-28T12:17:55.000Z	T2720737	4310	33.26613	137.29133	15348	-5.2	59.4	89.6	-273	-1	-1	RS41	405.6	6.8	-7687	10	2.6	-1	-1
7	2022-01-28T12:17:57.000Z	T2720737	4312	33.26614	137.29259	15337.6	-4.9	59	89.8	-273	-1	-1	RS41	405.6	7.8	-7687	10	2.6	-1	-1
8	2022-01-28T12:17:58.000Z	T2720737	4313	33.26614	137.29322	15332.8	-4.5	58.7	89.6	-273	-1	-1	RS41	405.6	7.8	-7687	10	2.7	-1	-1
9	2022-01-28T12:18:00.000Z	T2720737	4315	33.26614	137.29449	15324.2	-3.9	59.7	89.6	-273	-1	-1	RS41	405.6	7.8	-7687	9	2.6	-1	-1
10	2022-01-28T12:18:03.000Z	T2720737	4318	33.26613	137.2964	15310.5	-4.5	58.9	90.5	-273	-1	-1	RS41-SG	405.6	7.2	-7687	10	2.7	-1	-1
11	2022-01-28T12:18:04.000Z	T2720737	4319	33.26613	137.29703	15306.1	-4.4	59.3	90.5	-273	-1	-1	RS41-SG	405.6	7.8	-7687	10	2.7	-1	-1
12	2022-01-28T12:18:05.000Z	T2720737	4320	33.26612	137.29766	15301.8	-4.5	59.3	89.7	-273	-1	-1	RS41-SG	405.6	8.2	-7687	10	2.6	-1	-1
13	2022-01-28T12:18:06.000Z	T2720737	4321	33.26613	137.2983	15297.5	-4.6	59.5	89.9	-273	-1	-1	RS41-SG	405.6	8.2	-7687	10	2.6	-1	-1
14	2022-01-28T12:18:11.000Z	T2720737	4326	33.26616	137.30155	15274.3	-4.3	60.3	89.1	-273	-1	-1	RS41-SG	405.6	7.6	-7687	9	2.6	-1	-1
15	2022-01-28T12:18:12.000Z	T2720737	4327	33.26617	137.30219	15270.3	-3.9	60.5	89.8	-273	-1	-1	RS41-SG	405.6	7.6	-7687	10	2.6	-1	-1
16	2022-01-28T12:18:13.000Z	T2720737	4328	33.26617	137.30284	15266.6	-3.8	60.7	89.2	-273	-1	-1	RS41-SG	405.6	7.6	-7687	10	2.7	-1	-1
17	2022-01-28T12:18:14.000Z	T2720737	4329	33.26618	137.30349	15262.6	-4	60.7	89.1	-273	-1	-1	RS41-SG	405.6	7.9	-7687	10	2.7	-1	-1
18	2022-01-28T12:18:15.000Z	T2720737	4330	33.26618	137.30414	15258.5	-4.2	60.7	89.2	-273	-1	-1	RS41-SG	405.6	8	-7687	10	2.6	-1	-1
19	2022-01-28T12:18:25.000Z	T2720737	4340	33.26601	137.31066	15211.7	-4.6	59.5	94.9	-273	-1	-1	RS41-SG	405.6	7.4	-7687	10	2.6	-1	-1
20	2022-01-28T12:19:08.000Z	T2720737	4383	33.26477	137.3382	14943.7	-7.5	58.3	96.9	-273	-1	-1	RS41-SG	405.6	6.9	-7687	10	2.7	-1	-1
21	2022-01-28T12:19:13.000Z	T2720737	4388	33.26446	137.34129	14904.6	-6	59.8	94.9	-273	-1	-1	RS41-SG	405.6	7.5	-7687	10	2.7	-1	-1
22	2022-01-28T12:19:15.000Z	T2720737	4390	33.26437	137.34257	14891.4	-7.3	60.5	94.6	-273	-1	-1	RS41-SG	405.6	8.9	-7687	10	2.6	-1	-1
23	2022-01-28T12:19:16.000Z	T2720737	4391	33.26433	137.34322	14882.9	-9.1	60.7	94.5	-273	-1	-1	RS41-SG	405.6	8.9	-7687	8	2.6	-1	-1
24	2022-01-28T12:19:21.000Z	T2720737	4396	33.26396	137.34642	14839.7	-8.5	60.3	101	-273	-1	-1	RS41-SG	405.6	7.8	-7687	9	2.6	-1	-1
25	2022-01-28T12:19:22.000Z	T2720737	4397	33.26386	137.34706	14831.5	-8	61.1	100.2	-273	-1	-1	RS41-SG	405.6	7.8	-7687	9	2.6	-1	-1
26	2022-01-28T12:19:26.000Z	T2720737	4401	33.26349	137.3496	14793.8	-10.1	59.6	101.8	-273	-1	-1	RS41-SG	405.6	7.6	-7687	9	2.6	-1	-1
27	2022-01-28T12:19:27.000Z	T2720737	4402	33.26338	137.35023	14783.8	-10.2	60.3	102.9	-273	-1	-1	RS41-SG	405.6	7.6	-7687	9	2.6	-1	-1
28	2022-01-28T12:19:30.000Z	T2720737	4405	33.26301	137.35217	14753.6	-10.9	64.3	102.2	-273	-1	-1	RS41-SG	405.6	7.4	-7687	9	2.6	-1	-1
29	2022-01-28T12:19:37.000Z	T2720737	4412	33.26226	137.35678	14696.5	-6.7	64.8	99.9	-273	-1	-1	RS41-SG	405.6	6.9	-7687	9	2.6	-1	-1
30	2022-01-28T12:19:39.000Z	T2720737	4414	33.26204	137.35816	14680.2	-8.2	65.9	102	-273	-1	-1	RS41-SG	405.6	6.9	-7687	9	2.7	-1	-1
31	2022-01-28T12:19:47.000Z	T2720737	4422	33.261	137.36352	14611.9	-7.8	66.2	105.7	-273	-1	-1	RS41-SG	405.6	8.9	-7687	9	2.6	-1	-1
32	2022-01-28T12:19:48.000Z	T2720737	4423	33.26084	137.36421	14604.5	-7.1	66.7	105.7	-273	-1	-1	RS41-SG	405.6	8.9	-7687	9	2.7	-1	-1
33	2022-01-28T12:19:49.000Z	T2720737	4424	33.26068	137.3649	14597.5	-6.9	66.5	104.6	-273	-1	-1	RS41-SG	405.6	7.6	-7687	9	2.7	-1	-1
34	2022-01-28T12:19:53.000Z	T2720737	4428	33.26015	137.36764	14568.2	-7.2	66	103.9	-273	-1	-1	RS41-SG	405.6	8.4	-7687	9	2.7	-1	-1
35	2022-01-28T12:19:54.000Z	T2720737	4429	33.26	137.36833	14560.6	-7.7	66.9	105.2	-273	-1	-1	RS41-SG	405.6	8.4	-7687	9	2.7	-1	-1
36	2022-01-28T12:19:55.000Z	T2720737	4430	33.25983	137.36902	14553.2	-7.4	67.4	105.9	-273	-1	-1	RS41-SG	405.6	8.7	-7687	9	2.6	-1	-1
37	2022-01-28T12:19:56.000Z	T2720737	4431	33.25967	137.36972	14545.6	-7.4	67.5	105.5	-273	-1	-1	RS41-SG	405.6	8.7	-7687	9	2.6	-1	-1
38	2022-01-28T12:20:00.000Z	T2720737	4435	33.25906	137.37254	14516.6	-6.6	68.7	104.9	-273	-1	-1	RS41-SG	405.6	7.7	-7687	9	2.6	-1	-1
39	2022-01-28T12:20:02.000Z	T2720737	4437	33.25871	137.37397	14502.1	-7.4	69.5	107.5	-273	-1	-1	RS41-SG	405.6	8.4	-7687	9	2.6	08:29:38	-1
40	2022-01-28T12:20:04.000Z	T2720737	4439	33.25833	137.37538	14487.8	-6.7	69.3	107.4	-273	-1	-1	RS41-SG	405.6	8.6	-7687	9	2.7	08:29:38	-1

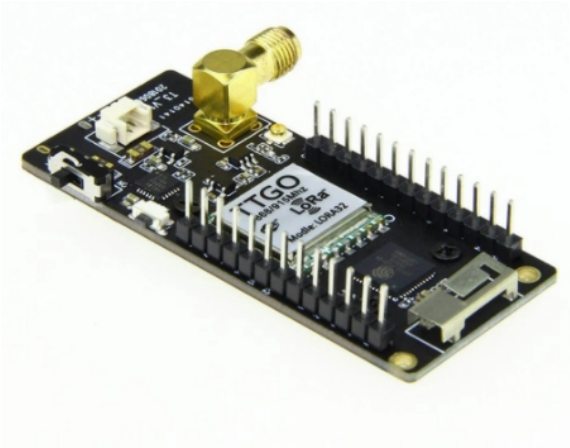
download to PC, tablet, or phone from home lan interface into device

radiosonde autorx

Software: rdzTTGOsonde

Inexpensive Option

- Widest mode support
- TTGO LoRa ESP32 (appx. 2,500 yen incl. shipping from AliExpress) + Antenna
- Load software and go
- WiFi only



https://github.com/dl9rdz/rdz_ttgo_sonde

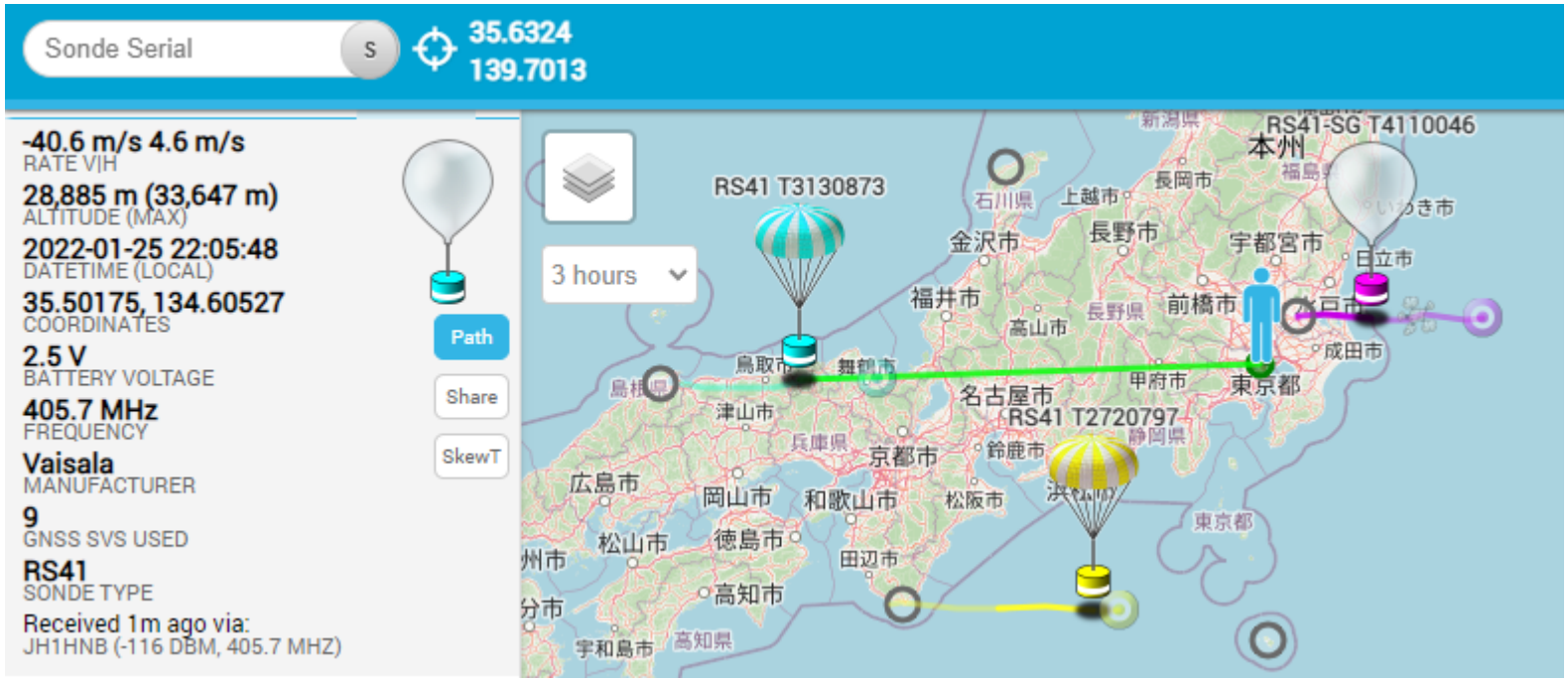
Radiosonde Support Matrix

Manufacturer	Model	Position	Temperature	Humidity	Pressure
Vaisala	RS92-SGP	✔	✔	✘	✘
Vaisala	RS41-SG/SGP/SGM	✔	✔	✔	✔ (for -SGP)
Graw	DFM06/09/17	✔	✔	✘	✘
Meteomodem	M10	✔	✔	✔	Not Sent
Meteomodem	M20	✔	✘	✘	Not Sent
Meteo-Radiy	MP3-H1 (MRZ-H1)	✔	✘	✘	✘

Only covers two of the 5 models so far observed in Japan.

rdzTTGOSonde

Software: rdzTTGOsonde

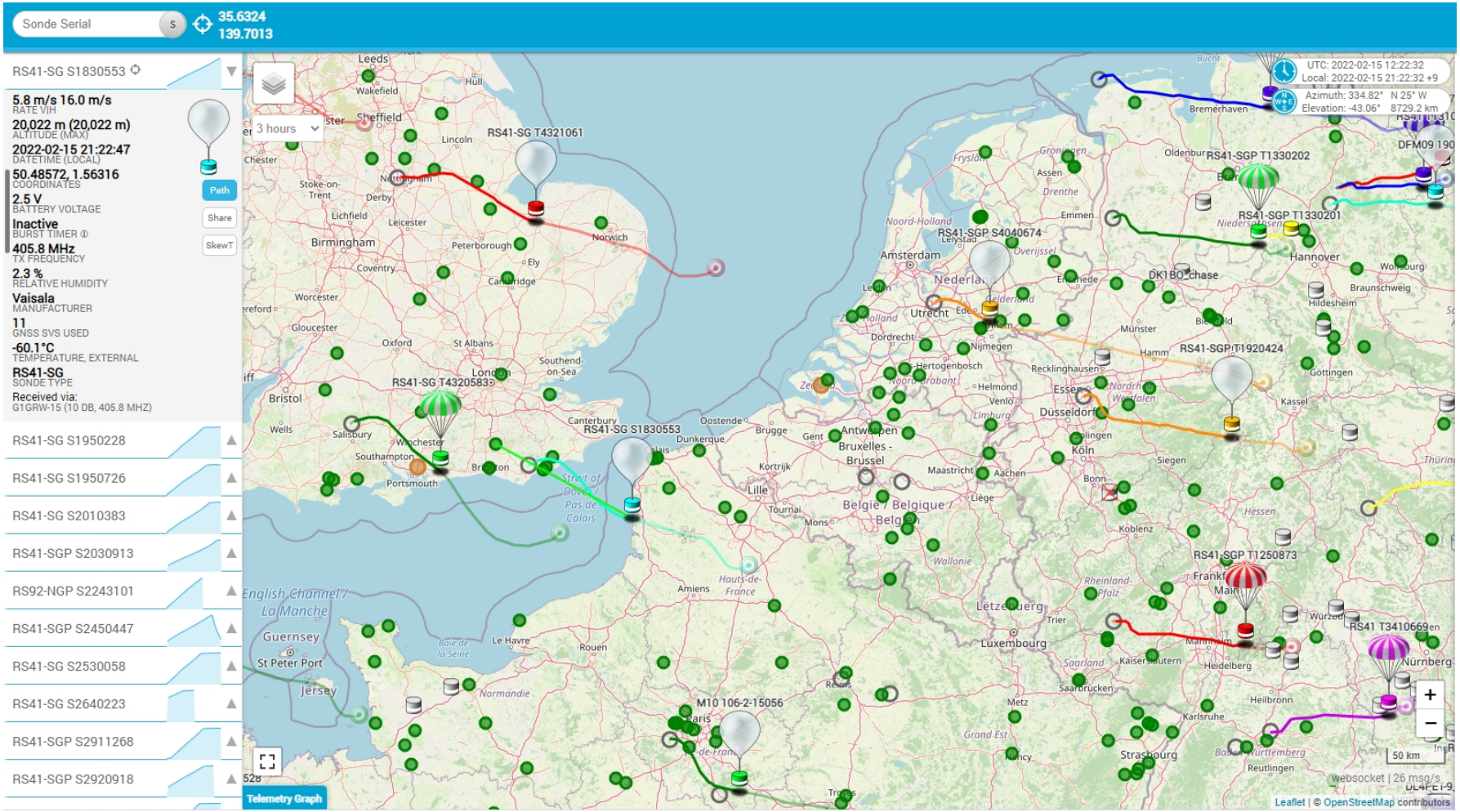


Hooking this up to my one decent 433MHz antenna (Diamond SG7700), I had initial impressive receiption of launches from Matsue, Shionomisaki, and Tateno right off the bat. Best 2,500 yen spent on radio in recent memory. After Auto RX inherited the antenna, it has suffered from poor reception. Worthwhile if you can use with a good antenna from a site with good eye-of-sight range.

rdzTTGOSonde

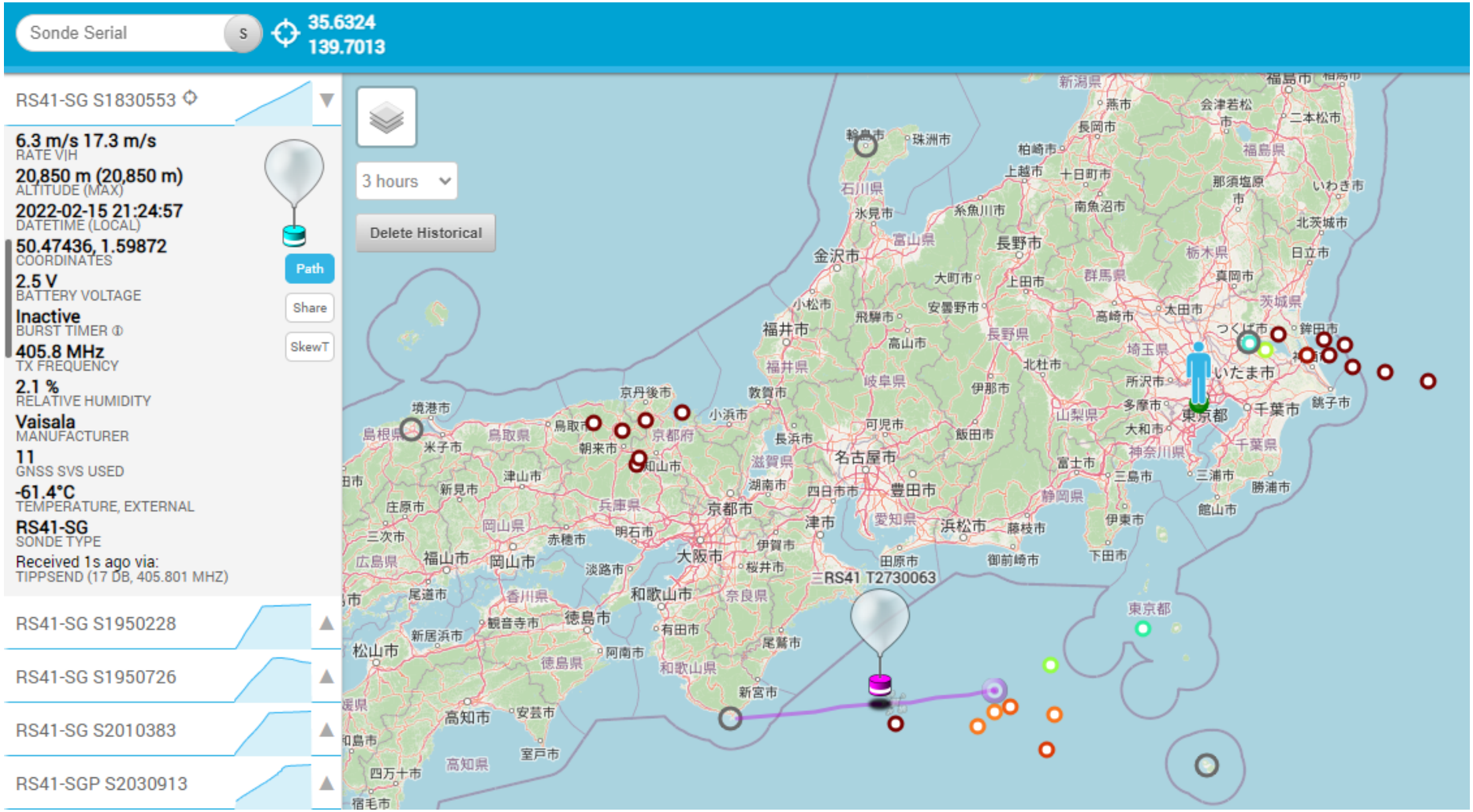
https://sondehub.org/

Sondehub - Data Aggregation



https://sondehub.org/

Sondehub - Historical



https://sondehub.org/ click on launch site, and press historical

Closing

It has been fun playing with this. Please give it a try, especially if you already have the components in your shack.

If you liked this, for other similar data exchange systems (air, marine, satellite, etc.) see:

https://www.reddit.com/r/RTLSDR/comments/sf9m0y/this_is_a_master_list_of_crowdsourced_data/

I also participate in FlightAware, and TinyGS and can recommend these too.