Problems with Ionosonde Data

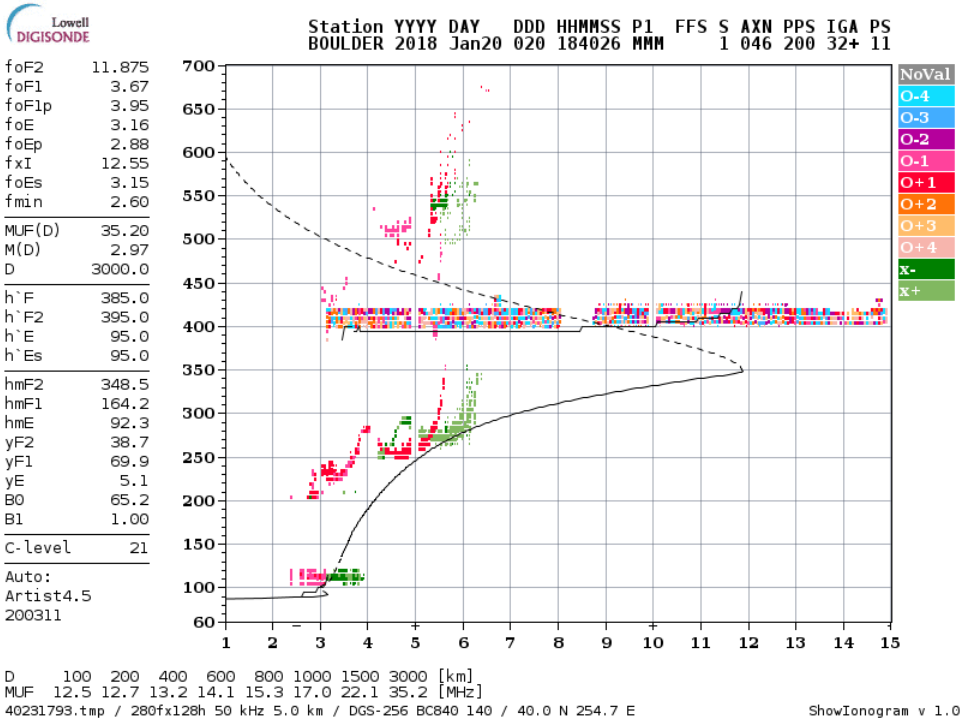
Carl Luetzelschwab K9LA November 2019

Over the years I've tried to use ionosonde data to help understand some unusual propagation events. The biggest problem I've run into is many times there isn't an ionosonde in the right place – or if there was, there wasn't any data.

Another problem with ionosonde data is bogus echoes. This doesn't happen often, but when it does it can lead you astray. A good example of this happened to me a while back. I was looking at the tabular data for the Boulder ionosonde for the month of January 2018. Here's an excerpt of that data from ftp://ftp.swpc.noaa.gov/pub/lists/iono_month/.

# UT Date	Time															
# YR MO DA	HHMM	foF2	hmF2	MUF(D)	D	h'F	yF2	fMUF	h'	fxI	foF1	foE	hmE	foEs	fbEs	ITEC
2018 01 20	1825	6.2	241	3.58	3000	221	72	5.5	255	6.9	4.0	2.6	105	2.5	-1.0	9.1
2018 01 20	1830	5.7	242	3.75	3000	206	42	5.3	255	6.5	3.8	2.7	95	2.7	-1.0	5.7
2018 01 20	1835	5.7	244	3.70	3000	212	48	5.5	270	6.5	3.6	2.6	100	2.9	-1.0	6.1
2018 01 20	1840	**11.9**	395	2.97	3000	385	38	11.8	420	12.6	3.7	3.2	95	3.1	-1.0	23.3
2018 01 20	1845	5.4	241	3.82	3000	213	46	5.1	250	6.2	3.8	2.7	100	2.7	-1.0	5.5
2018 01 20	1850	4.9	242	3.79	3000	210	31	4.7	260	5.8	3.8	2.6	100	2.6	-1.0	4.1
2018 01 20	1855	4.9	209	3.37	3000	210	83	4.4	285	5.8	3.0	2.7	95	2.7	-1.0	6.3

Note the very high foF2 value (highlighted in red) at 1840 UTC on January 20. My first thought was this was a significant enhancement in the F2 region. I could think of reasons for this from papers in the scientific literature (**Journal of Geophysical Research**, **Radio Science**, and others). But then sanity hit – maybe I should check the ionogram to make sure this was a valid data point. So I went to http://www.digisonde.com/stationlist.php and looked at the Boulder ionogram for 1840 UTC on January 20, 2018.



Oh, oh – this doesn't look good. The foF2 value should have been reported to be about 5.6 MHz, and not 11.875 MHz as indicated at the top of the data on the left side of the ionogram. As a side note, the true foF2 value is when the red ordinary wave trace goes vertical to the top of the ionogram. Unfortunately the auto-scaling software picked 11.875 MHz in the horizontal gibberish at a virtual height of just over 400 km. If this data would have been scaled by a human, this would have been caught – but auto-scaling is the norm nowadays due to the labor involved in humans doing the job. Another side note – fxI in the data on the left (akin to the extraordinary wave critical frequency) is thus also wrong, along with the various heights for the F2 region.

So what caused these bogus echoes? I talked to an ionosonde scientist with knowledge of the Boulder ionosonde, and the problem is related to another ionosonde co-located at Boulder. The system software is supposed to make both ionosondes transmit at the same time to avoid interference. For some reason, though, the system timing gets screwed up every once in a while and the other ionosonde transmits when the normal Boulder ionosonde is receiving. Thus the gibberish seen in the above ionogram is the other ionosonde transmitting at a wrong time.

I have other examples of bogus ionosonde data, and the problem appears to be mostly tied to the auto-scaling function interpreting the ionogram incorrectly. Regardless of these problems, I'm certainly going to continue to use ionosonde data in the future. But I'll always keep an eye out for unusual data. If it appears to be too good to be true, then maybe it isn't true.