Tropospheric Ducting on 2 Meters

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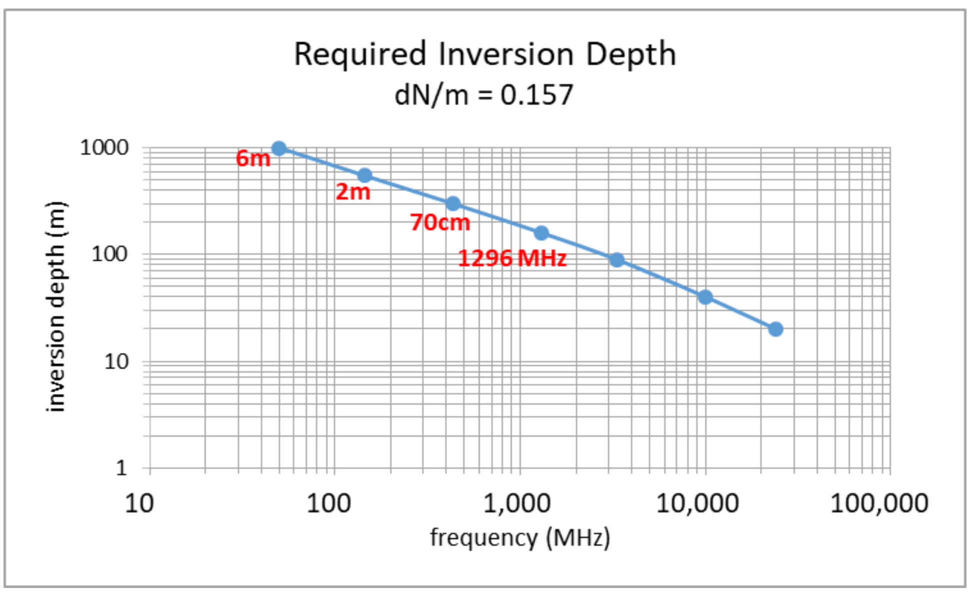
In early August I received an e-mail from Bill NE1B (in New Hampshire) telling of his QSOs with California stations on July 24, 2021 on 146.52 MHz FM. Bill worked his first station at 1735 UTC and twenty-two more stations from 2012 UTC to 2042 UTC.

One explanation of the propagation mode might have nothing to do with the atmosphere or the ionosphere. It might have been a man-made internet-linked scenario. Bill ruled this out due to his familiarity with the characteristics of internet-linking when he worked for Motorola.

Another explanation of the propagation mode might be sporadic-E. Bill commented that his experience with 2 meter sporadic-E between New Hampshire and Florida and between New Hampshire and Nebraska has been openings that last less than 15 minutes. So he didn't think sporadic-E over such a wide expanse (coast to coast) was the mode.

Another explanation of the propagation mode might be tropospheric ducting. This explanation struck a chord with me, and I took a deeper look at tropospheric ducting. Tropospheric ducting requires a temperature inversion of a minimum depth depending on frequency. The depth is the difference in altitude from when the temperature begins increasing and when it again starts decreasing.

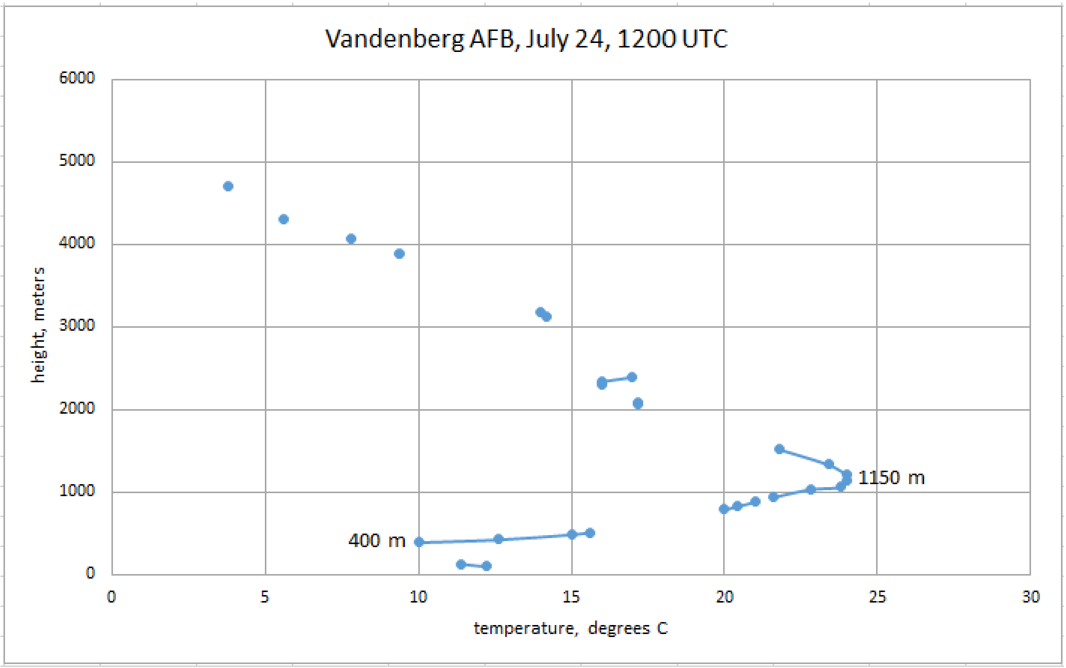
The first thing I did was look at Figure 12 in Chapter 3 of The ARRL UHF/Microwave Experimenter's Manual (1990). It gives the required inversion depth at various frequencies versus the index of refraction lapse rate. Pulling data from that figure at a typical lapse rate of dN/m = 0.157 and plotting the data in Excel gave the following result.



The original figure only went down to 432 MHz (70 cm), so I extrapolated the data down to 50 MHz (6 meters).

This plot tells us that the inversion depth under typical conditions for tropospheric ducting on 2 meters needs to be around 550 meters.

Next I downloaded radiosonde data from Vandenberg AFB in California at 1200 UTC on July 24. Plotting the data in Excel gave the following.



There's missing data, but it's pretty obvious that the inversion depth was about 1150 meters minus 400 meters = 750 meters. Thus it appears that tropospheric ducting is a valid explanation for these QSOs – at least on the west end of the path.

More temperature versus altitude data across the continental US would be required to have more confidence in concluding that tropospheric ducting was going on. If you're interested in doing this, radiosonde data is available at https://mesonet.agron.iastate.edu/archive/raob/.

If the lapse rate was higher (super-refractive conditions with dN/m greater than 0.157), the inversion depth required for 2 meter tropospheric ducting would be smaller. For example, at a lapse rate of dN/m = 0.250, the inversion depth would only need to be 200 meters.