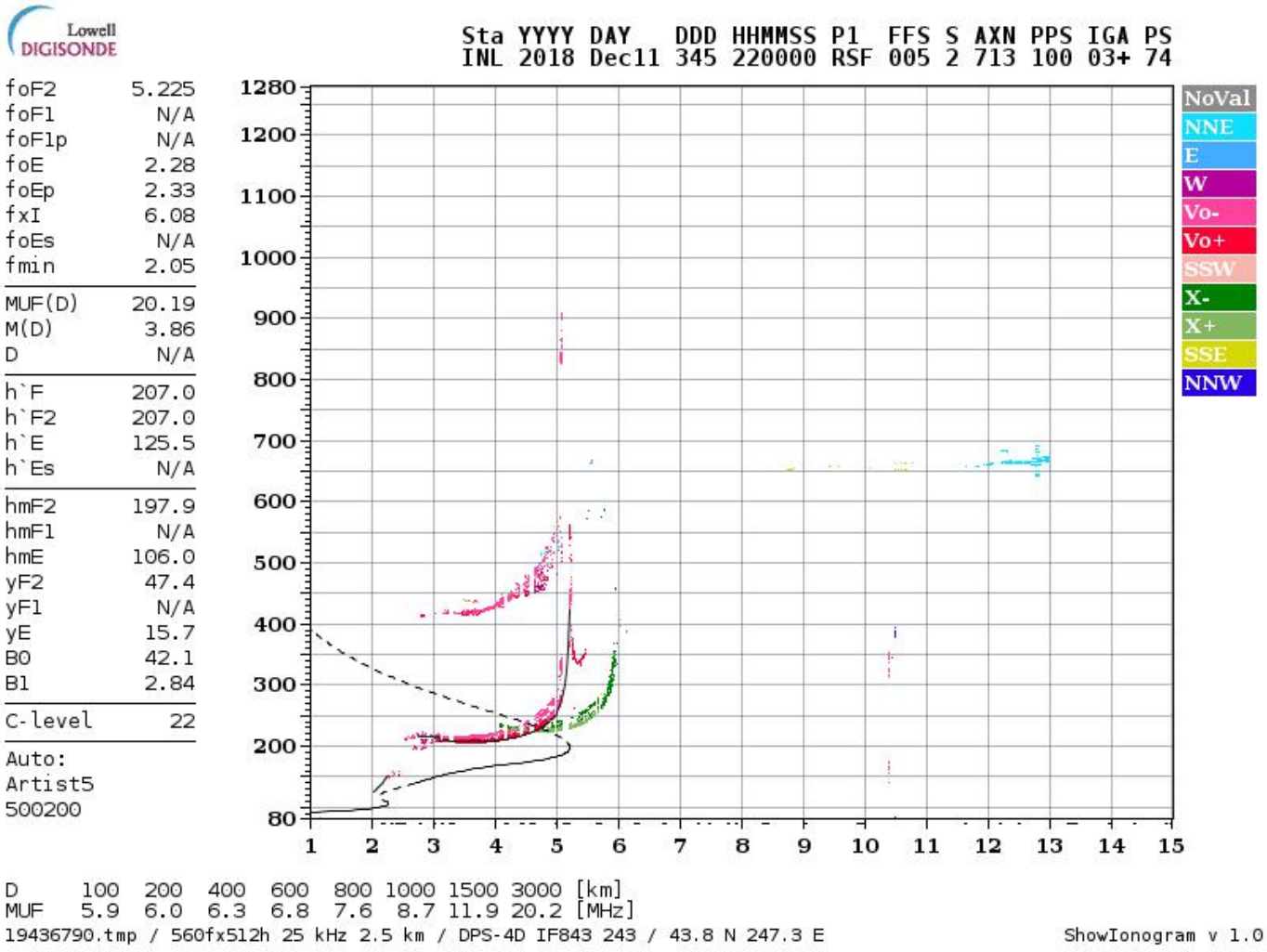
An NVIS Experiment on 40 Meters



W7RPK has been experimenting with local HF communications. The hypothesis behind his experiments are that NVIS or **N**ear **V**ertical **I**ncidence **S**kywave radio-wave propagation should provide usable signals in the range between groundwave and conventional skywave distances. The rule of thumb is this is between 30-400 miles. With the hills and valleys we have here in the west edge of the Williamette Valley, NVIS can be used to circumvent the lack of line-of-sight communications required by VHF/UHF radios, without the need of a repeater.

While not exactly a scientific experiment, this experiment consisted of a test of making contact between two hams, one to the west at a distance of approximately 3 miles, and one northeast at approximately 11 miles from the coordinator. Both the westerly ham (AA6TK) and northeasterly hams (W7OWO) were known to live in locations with nearby hills that limited VHF and restricted UHF communications in specific directions. The following graphic provides the elevation profile of

the terrain between W7RPK and AA6TK. W7RPK's QTH is on the left and AA6TK's is on the right. The distance is reported to be 2.72 miles with an over all elevation difference of about 30 feet, though close to AA6TK's location is a 241 foot ridge. This ridge is what is suspected to be the culprit of the issues of propagation with UHF and VHF. AA6TK frequently checks in on the YCARES WInlink Net using the WINMOR Winlink digital mode on HF using the W7YAM 40 meter RMS location in downtown McMinnville. The radio path for the experiment just a little less than mile closer and the ridge is about 70 feet lower than the radio path to the EOC. With the successful access to the EOC, it was expected the experiments contact would work. Expectations were met as the phone contact was successful.

The elevation profile between W7RPK and W7OWO is little more varied. As before W7PRK is on the left and W7OWO is on the right. The distance between stations is reported to be 10.8 miles, with three elevated ridges between QTH's. The closest ridge to W7OWO is about 1.25 miles distant and has an elevation gain of 450 feet above W7OWO's QTH, the second ridge is about 2 miles with an elevation gain of 550 feet,and the third ridge is about 3 miles away and has an elevation gain of 750 feet. The remaining ground is fairly flat with crossings of the Yamhill river and it's tributaries. The closeness and elevation of these ridges are the suspects of propagation issues at the VHF and UHF. The path to the EOC is nearly identical in both distance and elevation changes. In the past year W7OWO has only had one successful connection with the EOC's W7YAM 40 meter WINMOR Winlink RMS station. As expected the experiment's attempted contact failed.

The question now arises why does one work and expectantly somewhat regularly and the other is expected to fail to work, though may have an occasion that it works? After some discussion, the agreed upon hypothesis is that with the AA6TK to W7RPK path, it's distance is short enough that the elevated ridge isn't high enough to block the HF ground wave from making it between the two stations as it does the VHF/UHF signals. Also the distances are too close to be viable for a normal skywave propagation, but since the ground wave is present, it works. While with the W7RPK to W7OWO path should still fall within expected ground wave distances, the magnitude of the elevated ridges appear to block the transmitted ground wave. This only leaves sky wave propagation. Falling back on tools described in the May 2018 MARC wireless, ionograms, we looked at the propagation on 40 meters. The graphic on the following page is the ionogram from the Idaho National Laboratories that was generated within several minutes of the attempted contact. The black line represents the critical frequency at the time, as you can see it doesn't even come close the 7 MHz frequency of the attempted 40 meter contact. So at the time vertical radiated transmission just pass on through ionosphere with now refraction. Looking at the MUF to see the impact on obliquely radiated transmissions would have a skip distance of at least 600 kilometers (375 miles). Well over the 10 miles.

Unfortunately we looked at the ionograms after we had concluded testing in our attempts to explain the failing contact. I looks like if we had tried 80 meters, there may have been a chance for success!

The ionogram on the first page was taken around the time of the W7PRK to AA6TK contact testing. It shows that it is most likely that the contact had to be via the ground wave, as the ionogram shows very similar measurements, and 40 meter sky wave would have a theoretical skip distance of 435 miles. It would have been interesting to have tried 80 as it looks like there should be some refraction in the 3 MHz range. Would there have been a better signal? Looks like we need some more experimenting!