Larry D. Wolfgang, WR1B, tc@arrl.org

The NVIS Myth — A Modeling Study

An Exercise in Antenna Modeling

There has been a lot of talk over the past few years about the advantages of the Near Vertical Incidence Radiator (NVIR) for local HF communications. This is just a dipole strung low to the ground, for which the maximum radiation is straight up. Because local coverage requires a high (near 90°) takeoff angle, it is suggested, therefore, that a low dipole will outperform a high dipole in local (< 200 mile) communications. As we shall see, this is unlikely to be true.

When we model a horizontal half-wave dipole in free space, we see a null along the wire and a maximum at right angles to the wire, which includes the high angles required for local communication.[1] At 3.7 MHz, as we bring this model dipole toward a *MININEC* ground, we find that the 0° maximum becomes a partial null around 130 feet, but at 60 feet we have a smoothly rounded pattern pointing straight up. If we do the modeling using a *MININEC* ground simulation, the 90° performance appears to continue to increase as the antenna is lowered. (I stopped the simulation at 10 feet, as a practical limit for safety reasons.) Figure 1 (open circles), shows this behavior. What could be better?

But *MININEC* ground models neglect ground losses, and these losses are considerable when the antenna is as close to ground as this (10 feet is 0.04 λ at this frequency). The High Accuracy Ground model does a better job of accounting for these losses, and gives a very different picture. With this model (Figure 1, filled circles) the highest signal strength at 90° is from a dipole around 50 feet above ground; this will be at least 6 dB (an S unit) better than the same dipole at 10 feet above ground. Above 60 feet, a null reappears in the center of the pattern, but these heights are impractical for most amateurs, especially for emergency work.

Any of these antennas will have much greater radiation at 90° than a vertical antenna. For comparison, I modeled a 72-foot vertical over four ¼ λ radials, using the high-accuracy ground, and plotted it against the dipole at 10 feet, the worst of the dipoles. At 90°, the vertical has (theoretically) no radiation, and, as seen in Figure 2, at any angle above 30° the dipole performs better than the vertical. This, as much as antenna inefficiency, may account for the poor signals from mobile radios at this frequency.

Therefore, if you desire the strongest signal from your real dipole at "cloud warmer" angles, use a dipole between 40 and 60 feet above ground. Going higher than this is counterproductive, as well as expensive.

If you can't get to 40 feet, go as high as you can. Isn't this what most of us have been doing all along, anyway? — *73, George Kidder, W3HBM, 509 Norway Dr, Bar Harbor, ME 04609:* **gkidder@mdibl.org**

[1]Roy W. Lewallen, W7EL, *EZNEC* v. 5.0.58.

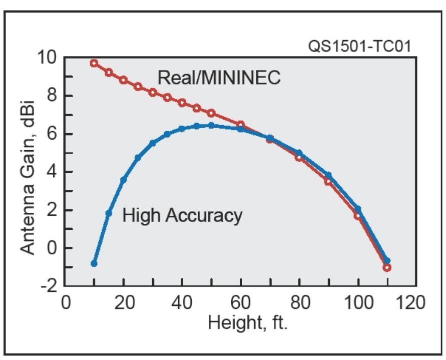

Figure 1 — Gain at 90° (straight up) of a dipole cut for 3.7 MHz at different heights above ground, for *MININEC* ground and Real High-Accuracy Ground. In each case the ground model assumes a conductivity of 5 mS and a dielectric constant of 13; "good average soil." Filled circles are the real, high-accuracy ground; open circles are the *MININEC* ground. The good *MININEC* results at lower heights are because *MININEC* neglects ground losses. Over real Earth, a height of 40 to 60 feet seems to be optimal, and only at greater heights is there any disadvantage to using a high dipole for local coverage.

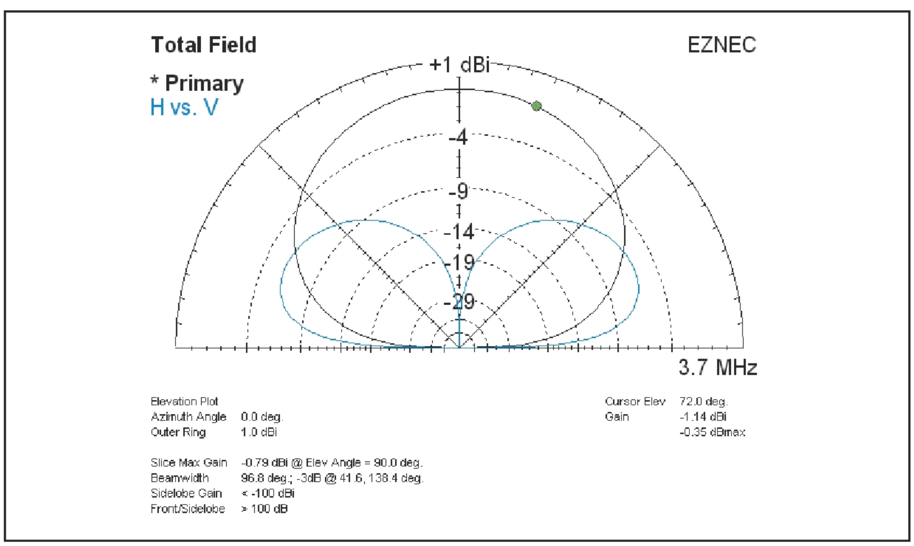

Figure 2 — Comparison of computed patterns over high-accuracy ground for a dipole at 10 feet (black) and at 70 feet vertical (blue). Even at this low height, the dipole greatly outperforms the vertical at all elevations above 30°.

No Spectrum Analyzer? No problem!

Recently I was trying to track down a