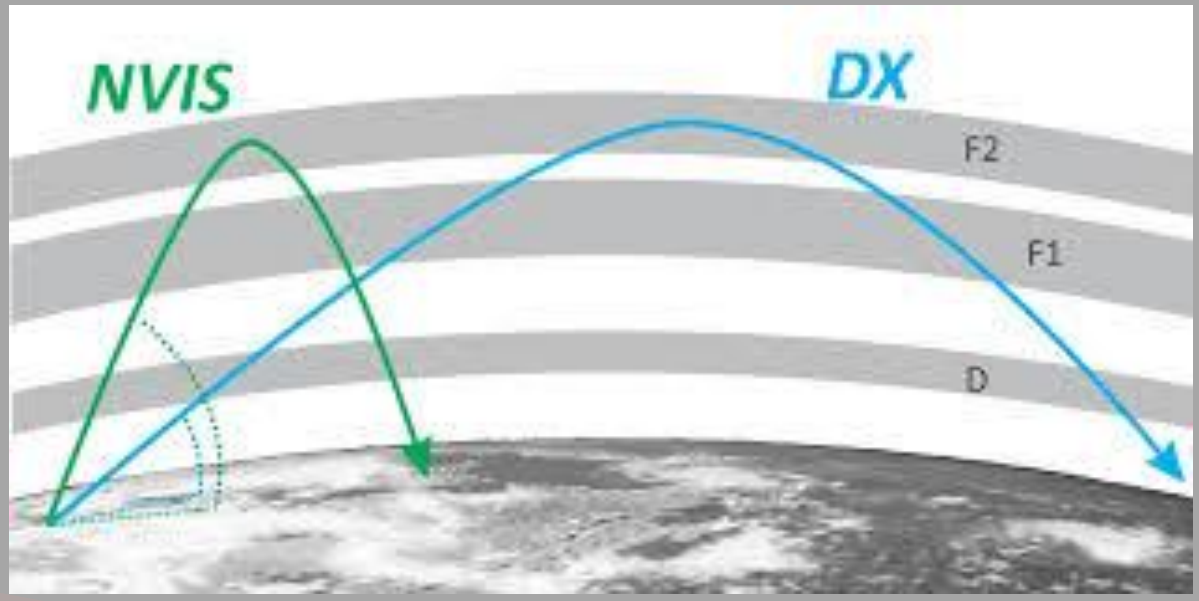
NVIS Antenna Communications

By W3CDG

NVIS – What does that mean?

- Near Vertical Incident Sky wave
  - High Take off angle
- 200 – 300 Mile coverage (Or greater)
- Great for Emergency Communications

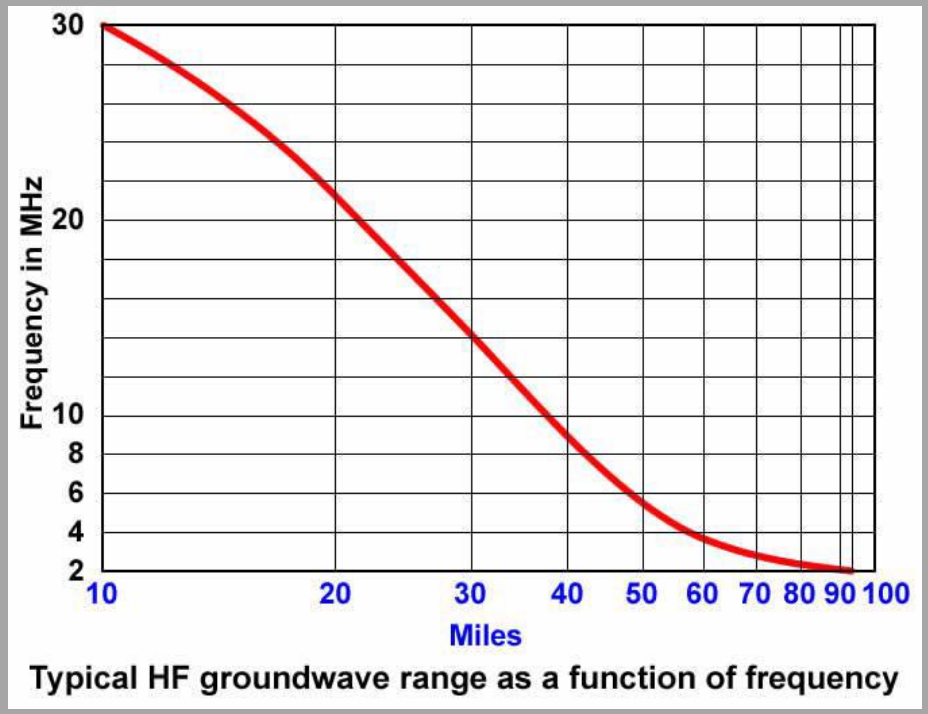


Advantages of NVIS

- NVIS covers the an area greater than that of the ground wave signals, and due to the angles, terrain is less of a concern.
- Longer distance without a repeater or other infrastructure.
- Easy antenna setup, height isn't as much of a concern. 15 – 30' works great!

Local Communication – Groundwave

- As the name implies, ground waves travel along the ground
- As the frequency increases, the maximum ground wave distance decreases



Typical HF groundwave range as a function of frequency

Time and Frequency

- What Band to use:
- Quick Answer:
  - Nighttime – use 80m
  - Daytime – use 40m

- Why?????? → lets find out!

Time & Frequency

- From our Radio Wave Presentation
  - The E-layer is densely ionized during the day
  - This reliably refracts 40 and 30 meter signals
- This makes 40 meters a good daytime NVIS Bands
  - Remember however, that the E-layer MUF drops rapidly after sunset.

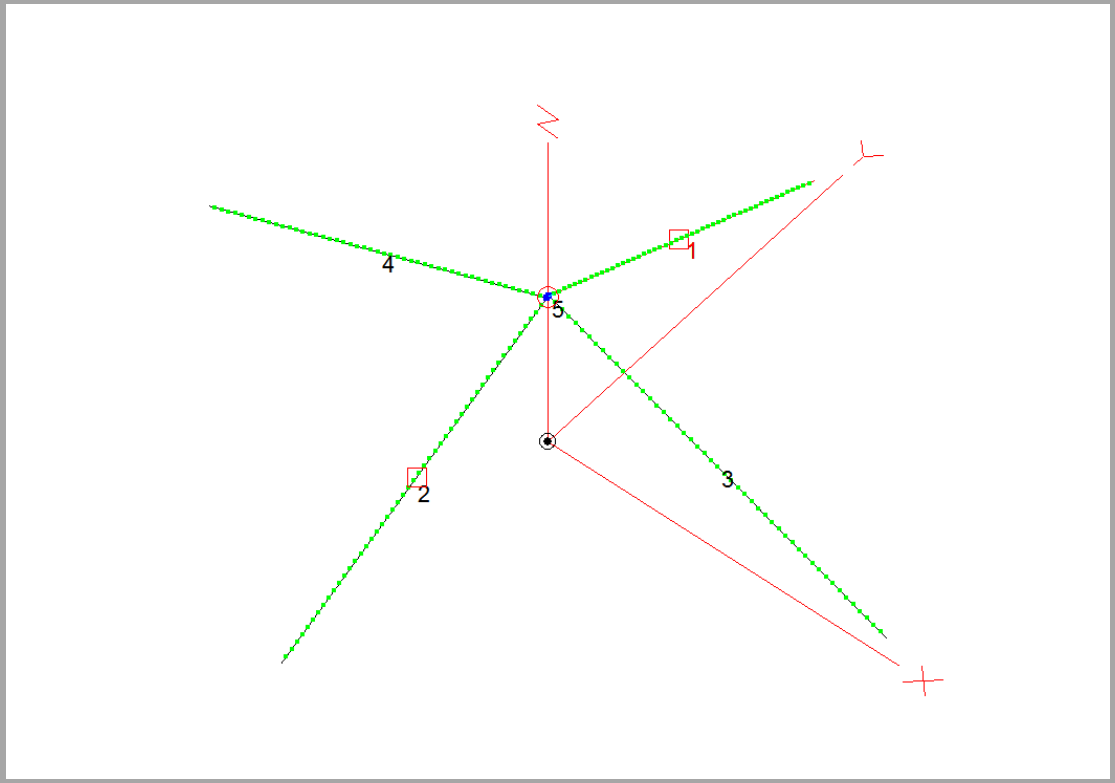
Time & Frequency

- So since During the day, the D-Layer absorbs most propagation below 4 MHz
  - 40 meters is > than 4 MHz so the signals can pass through the D-Layer into the E-Layer where they are refracted
  - Since the E-Layer MUF drops after sunset, BUT the D-Layer disappears at sunset.
- This makes 80 meters unreliable during the day, but good at night.

Antennas

- There are many different NVIS Antenna designs
- I've been modeling and focusing on a loaded Inverted V.

Consists of Full Sized 40 M legs crossed with Center loaded 80 M legs of approximately the same length



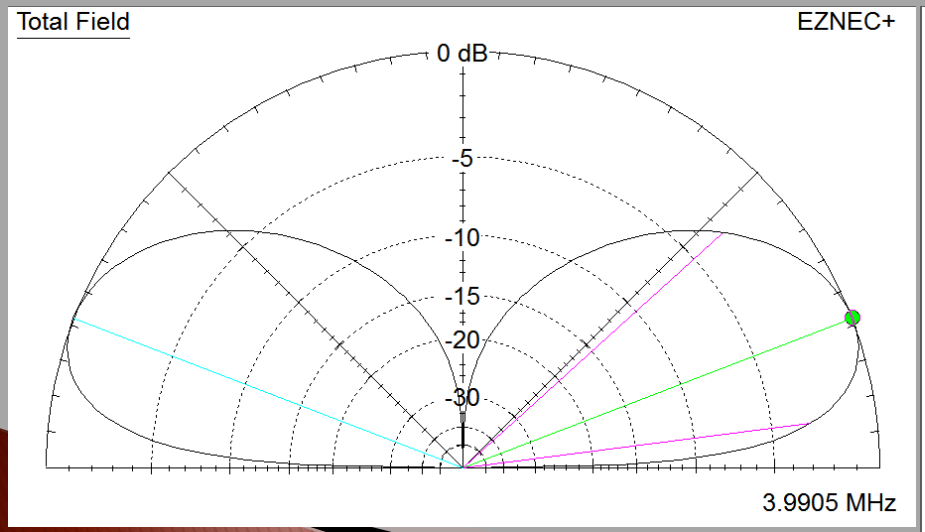
Loaded Inverted V

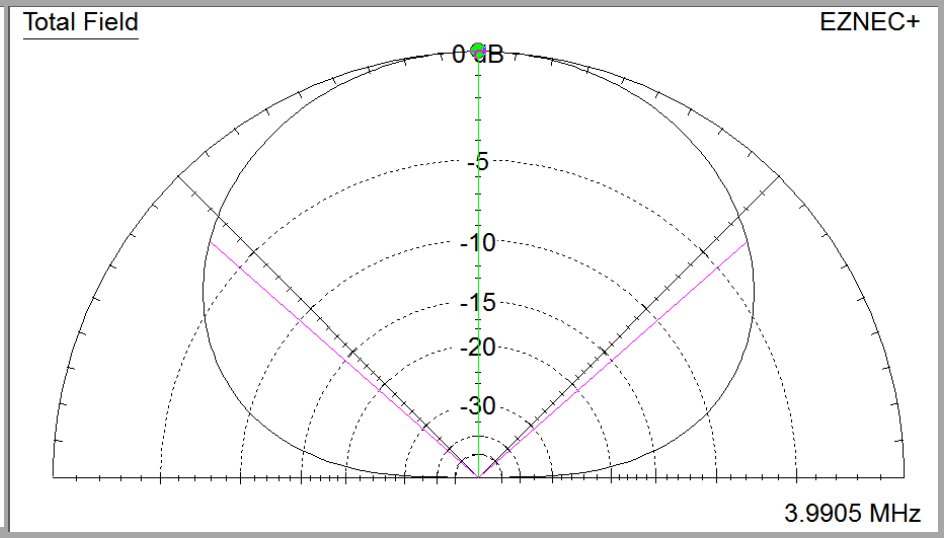
Pros:
Small Foot Print
Easy to deploy
Portable, light weight
Antenna is support,
No additional guy wires

Cons:
Coils are a compromise
Narrow Bandwidth on 80

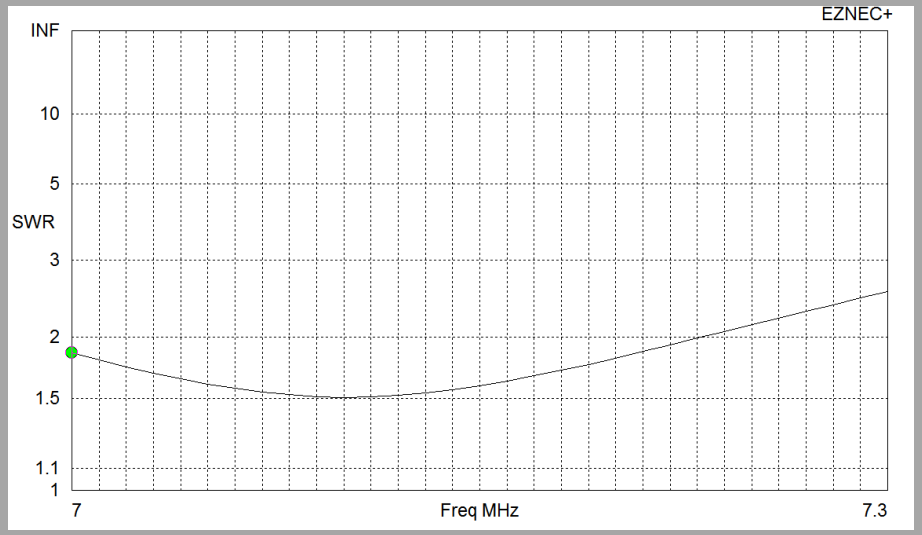
Loaded Inverted V

- Same Antenna / Different Heights
  - Take off angle and beam width
    - ¼ λ: TOA = 21°, BW: 27.6°
    - NVIS (15 – 3 feet): TOA = 90°, BW: 138.7°



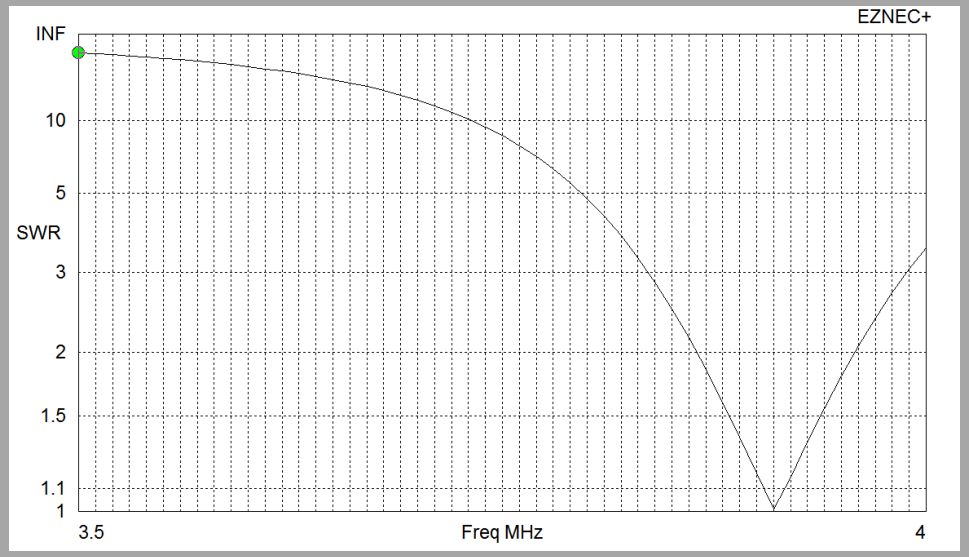


Loaded Inverted V – Models

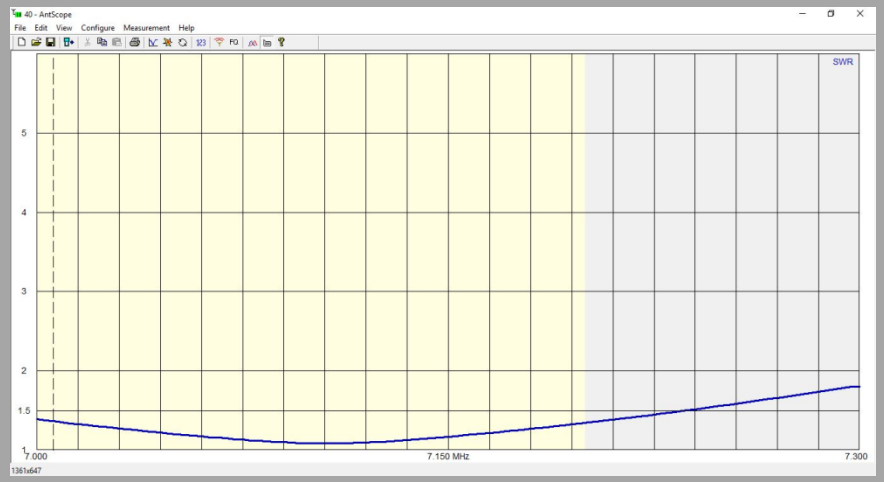


- 40 M SWR < 3:1 across the entire band
- Internal Tuners in most radios can handle this.

- 80 M is a loaded compromise
- 80M SWR bandwidth about 140 kHz

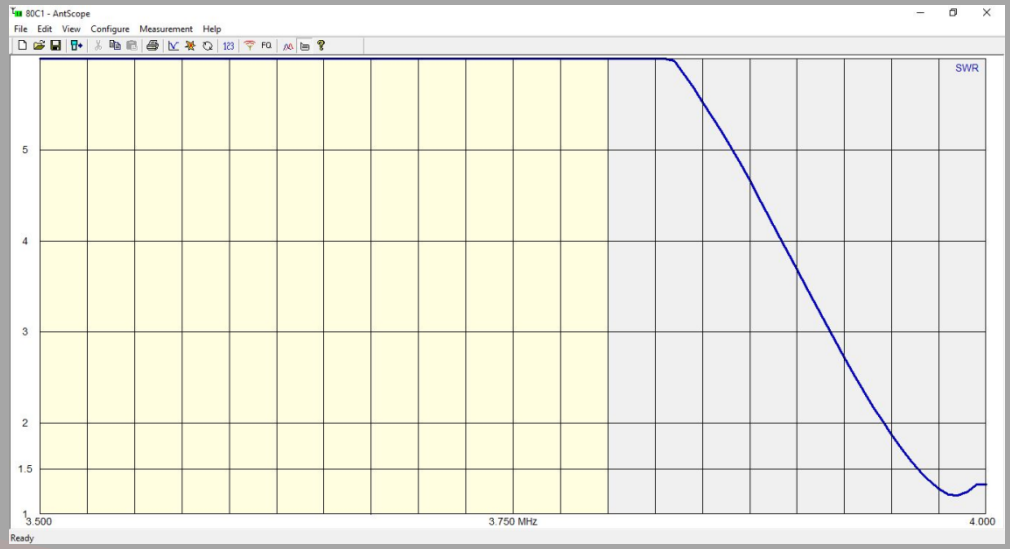


Loaded Inverted V – Real World



- 40 M SWR < 3:1 across the entire band
- Matches the Model pretty well!

- Tuned a little higher, but still matches the model!
- I love it when math matches the Real world!



Load Losses

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--------------- SOURCE DATA ---------------

Frequency = 3.91 MHz

Source 1        Voltage = 70.93 V at -0.56 deg.
                Current = 1.415 A at 0.0 deg.
                Impedance = 50.12 - J 0.4892 ohms
                Power = 100.4 watts
                SWR (50 ohm system) =  1.010  (50 ohm system) =  1.010
```

- Trading Size for Efficiency
  - 40m elements full size
  - 80m elements ½ size
    - Match length of 40m
  - 15.25 Watts lost in Coils

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---------------- LOAD DATA ----------------

Frequency = 3.91 MHz

Load 1          Voltage = 1133 V at 266.14 deg.
                Current = 1.332 A at 176.42 deg.
                Impedance = 4.3 + J 851 ohms
                Power = 7.625 watts

Load 2          Voltage = 1133 V at 86.02 deg.
                Current = 1.332 A at -3.69 deg.
                Impedance = 4.3 + J 851 ohms
                Power = 7.626 watts

                Total applied power = 100.4 watts

                Total load power = 15.25 watts
                Total load loss = 0.716 dB
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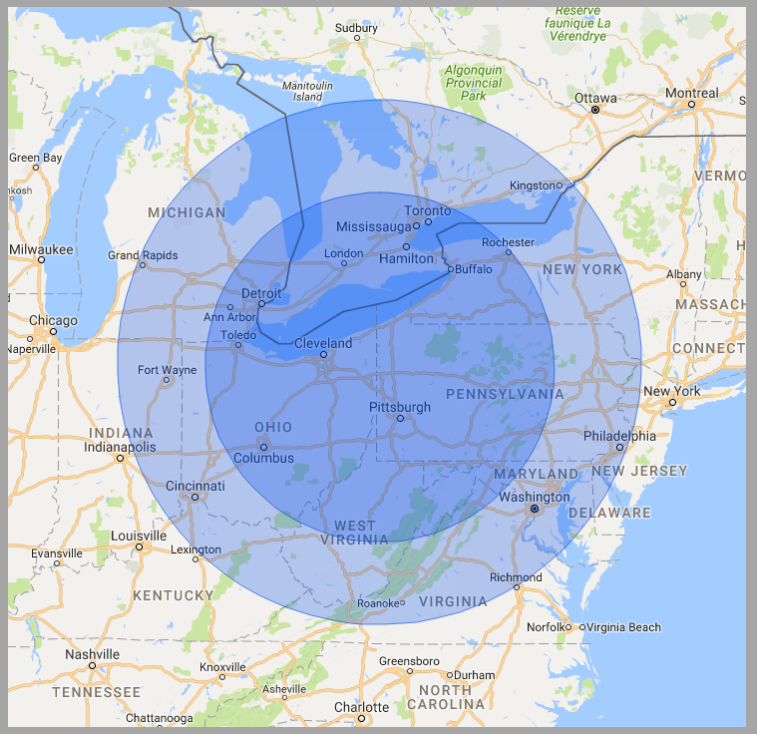
NVIS Coverage

- The two circles show 200 and 300 miles centered on Mercer County.
- 300 miles covers all of Pennsylvania
- HF Nets on Sat and Sun

show this to be fairly reliable.



Questions?